

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
Detroit, Michigan



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Vol 48

JANUARY 1947

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RADIOLOGY

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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No 1

Treatment of Malignant Tumors of the Testis

Review of 100 Cases¹

G M KELBY, M D, and K. WILHELM STENSTROM, Ph D

University of Minnesota, Minneapolis, Minn

THE INCIDENCE of malignant testicular tumors is relatively low. It has been estimated by Cade that they constitute 1 to 1.5 per cent of all malignant tumors in males and that they make up about 3 per cent of neoplasms of the genito-urinary tract. Pack and LeFevre reported an incidence of 1 per cent among 16,565 patients with malignant tumors seen at Memorial Hospital, New York, while Dean at the same institute in 1935 found 2.09 per cent of all malignant neoplasms in males to be testicular tumors. In regard to all male hospital admissions, it may be mentioned that Tanner in 1922 found one testicular tumor for every 2,000 patients.

The present study is based on the tumors of the testis treated at the University of Minnesota Hospitals from 1926 to 1943 inclusive. The total number amounted to 100 and they were placed in three groups: 34 cases were not classified as to type, while 37 were seminomas and 29 were carcinomatous mixed tumors.

ETIOLOGY

The average age in this series was for seminoma 37.6 years and for carcinomatous mixed tumors 29.4 years. This is in agreement with the statement of Cade that teratomatous tumors occur chiefly between

twenty and forty years, and the seminomas between thirty and fifty.

A history of trauma was obtained in 15 per cent of the cases. This is somewhat lower than in series reported by other authors. Russell Howard obtained a history of trauma in 5 cases out of 27, Nash and Leddy in 21 out of 103. The figures of some authors are as high as 50 per cent.

Cryptorchidism was present in 8 cases. Nash and Leddy reported an incidence of 8.7 per cent and Dean found 35 cases in a series of 245, or 14.3 per cent.

Hydrocele was observed in 6 patients, and in 3 of these a malignant tumor of the testis was discovered during the operation for hydrocele.

CLASSIFICATION

Classification of malignant tumors of the testis is a confused subject, and opinions vary greatly. At the University of Minnesota Hospitals we follow E. T. Bell's classification. Bell states:

"Testicular tumors may be divided into four groups: adult teratomas, carcinomatous mixed tumors, seminomas, and chorionepitheliomas."

"1. Adult teratomas may be typical dermoid cysts containing hair, fatty material, teeth, etc., or they may consist of many small cysts separated by solid tissue. These tumors are rare, develop slowly over many years, and offer relatively good prognosis."

¹ From the Department of Radiology and Physical Therapy of the University of Minnesota and the University Hospitals, Minneapolis, Minn. Accepted for publication in January 1946.

"2 Carcinomatous mixed tumors are soft cellular growths consisting chiefly of epithelium in form of cysts or solid masses of carcinomatous structure. Cartilage and myxomatous tissue may be found scattered through the tumor.

'3 Seminoma is the most common form of testicular neoplasm. It consists chiefly of rounded or polyhedral clear cells arranged in thick solid cords and bearing some resemblance to testicular tubules. Little or no cartilage is present.

"4 Chorionepithelioma is a malignant tumor arising from chorionic epithelium. The great majority develop within the uterus but they arise also in the testes and rarely in other situations. A teratoma of the ovary or mediastinum may develop chiefly as a chorionepithelioma. In the testis the growth is interpreted as a one sided development of a teratoma. It is distinguished even in its metastases from other tumors by the characteristic syncytial and Langhans cells, occurring independently of villi.

When the present series of cases was discussed with Dr Bell, he stressed the fact that true testicular teratomas are rare and that the diagnosis could not be made unless the whole tumor were carefully studied. None of the cases in this series which he examined fell into this group and he did not believe that there was enough evidence to classify any of these as adult teratomas. Because of the uncertainty of classification, all available slides were re-examined by Dr Bell and Dr McCartney. Only those definitely classified by them were typed, the others are included in the unclassified group. No chorionepitheliomas were encountered in this group of cases. A patient with this diagnosis was, however, treated in 1944.

It is difficult to state how these cases would be arranged in other classifications, but most of the seminomas would probably be called embryonal carcinomas by many pathologists, while the carcinomatous mixed tumors might be interpreted mainly as adenocarcinomas.

SYMPTOMS

The onset of the disease is characteristically insidious. One of the first symptoms noted by the patient is enlargement of the involved testis, and the tumor is often accidentally found. An injury frequently calls attention to the mass, while

in other cases the tumor is discovered during a routine physical examination.

As a rule, the tumor is painless during the early stages, but as the disease advances, dull pain and discomfort are usually experienced, as in a number of our cases. Backache, a feeling of fullness, and nausea, sometimes with vomiting, were generally associated with metastasis to the retroperitoneal nodes. Chamberlin and Jamison state that excretion urogram often demonstrate the presence of abdominal metastases before there is any clinical evidence. Dyspnea, cough, and enlarged supraclavicular nodes usually indicate metastasis to the lungs and mediastinum. In a few of our patients, however, supraclavicular nodes appeared without any sign of metastasis in the chest.

METASTASES

Metastases were known to be present in 65 per cent of our series, the most common site being the retroperitoneal nodes. Thirty patients had palpable abdominal masses at the beginning of irradiation. In most of these cases the usual symptoms of backache, a feeling of fullness, nausea, and abdominal discomfort were present.

Metastasis to the inguinal region was next in frequency. Eighteen patients showed either involvement of the inguinal nodes or a more superficial mass in the scar from the previous incision. Metastasis to the inguinal nodes is an advanced finding and indicates perforation of the capsule of the testis.

Twelve patients had metastases in the lungs and 6 showed mediastinal masses without demonstrable pulmonary involvement. In 6 cases a left supraclavicular node was enlarged. Four patients had clinical evidence of metastasis to the brain.

Metastasis to the retroperitoneal nodes cannot be established until large masses are present. Early involvement of these nodes cannot be determined by palpation, nor is it demonstrable directly or indirectly on the x-ray film. It is probable that undiagnosed metastatic nodes are present in most of our other patients, particularly in those

with highly malignant seminomas. It is for this reason that radiation therapy is given routinely to the retroperitoneal chain of lymph nodes whenever a diagnosis of seminoma has been made following simple orchiectomy.

Metastases in the mediastinum, lungs, and superficial nodes can be demonstrated before they have become too large for adequate treatment. As irradiation to all these areas would mean considerable hardship for the patient, we have applied x-ray therapy only for proved involvement.

DIAGNOSIS

Early diagnosis of malignant testicular tumors is of the utmost importance in order that adequate treatment may be instituted before extensive dissemination has occurred. In our series, 65 per cent of the patients had evident metastases on reporting for irradiation. Dean states that within three months of the first symptoms, 67 per cent of these tumors have metastasized.

A diagnosis of testicular tumor should be made from clinical examination. The physical examination should be complete and include a blood test for syphilis and biological tests for gonadotropic hormones. Biopsy is not advisable, but the testis should be removed for histologic study if malignant growth is suspected. Malignant testicular tumors should be differentiated from hematocele, gumma, benign tumor, tuberculosis, and hydrocele.

TREATMENT

The treatment of malignant tumors of the testis was at first surgical, and consisted of simple orchiectomy. The results were not encouraging. Hinman reported 258 cases with 5.6 per cent five-year cures. Similar results have been obtained by other American and European surgeons.

Radical surgery was next advocated by Chevassu and Hinman. The procedure consisted of removal of the primary lesion and the lymphatics from the testis, including the retroperitoneal nodes. Hinman, in 1933, reported 100 cases in which

radical surgery had been performed, with 17 per cent five-year cures. In 1938 he published a series of 58 cases, in only 3 of which radical operation was performed.

The present day treatment of testicular tumors in various clinics consists of simple orchiectomy followed by irradiation. Pre-operative irradiation is advocated by some. In simple orchiectomy as performed by Hinman and others, through an inguinal incision, the spermatic cord is clamped and cut high at the internal abdominal ring with a cautery, after which the testicle is removed.

It seems advisable to classify the tumors carefully and use a specific method of therapy for each type. It is our opinion that carcinomatous mixed tumors should be treated by radical dissection if the patient's condition permits, and that seminomas be treated by simple orchiectomy and post-operative irradiation to the retroperitoneal nodes. Adult teratoma should be treated by simple orchiectomy only.

The plan of treatment followed at the University of Minnesota Hospitals up to the present time has been simple orchiectomy followed immediately by irradiation (220 kv p, 15 ma, 1 mm Cu plus 1 mm Al filter, h v l 1.7 mm Cu, target-skin distance 70 cm). Patients without clinical evidence of metastasis were treated through two abdominal fields, one anterior and one posterior, the size of the field depending on the case. The anterior field covered an area from the xiphoid process to the pubis, about 15 cm wide, with a corresponding posterior field. At the present time two anterior fields are used, one for the upper abdomen and a lower field which includes the inguinal region of the involved side. The posterior field is used as before. About 2,000 r in air were given to each field over a period of three weeks. The average daily dose was 200 r in air.

If a large abdominal mass was present, intense treatment was at first directed to that area only, later, other areas were treated if local response had been obtained and the patient had recovered from the debilitating effect of the earlier therapy.



Fig 1 Roentgenogram of chest made Jan 27, 1943. Note pleural effusion on right producing pseudo-diaphragmatic shadow. In addition, there is some elevation of the diaphragm probably from a large abdominal mass. There is no evidence of peripheral metastasis but there is some enlargement of the hilar shadow on the right, with some atelectasis of the right lower lobe indicating a metastasis in the mediastinum. (Report by L. Rigler.)

Fig 2 Roentgenogram of chest made May 11, 1943. The right diaphragm is now normal in position and the effusion has disappeared. Three large masses in the mediastinum representing metastases in the right and left peribronchovascular and in the left perihilar group of lymph nodes are now apparent. Note the emphysematous lungs and the absence of peripheral metastases. There is a shadow in the left upper lobe probably representing an old healed minimal tuberculosis. (Report by L. Rigler.)

The usual measures were taken to reduce irradiation sickness to a minimum.

RESULTS OF TREATMENT

In this report it should be noted that survival time is consistently figured from the first x-ray treatment given at the University Hospitals.

1 *Seminomas* (Table I). Thirty-seven, or 56 per cent, of the 66 classified cases in which histologic diagnosis had been verified were seminomas, 65 per cent of the patients in this group had known metastasis when irradiation was begun.

The average period of time elapsing between surgical operation and the beginning of irradiation was three and a half months. Orchiectomy was performed by local surgeons in many of our cases, and some of the patients failed to report for follow-up treatment until new symptoms had developed.

In all but 2 cases of the seminoma group simple orchiectomy was performed, fol-

TABLE I THIRTY-SEVEN CASES OF PROVED SEMINOMA OF THE TESTIS

Year	No of Cases	Years of Survival—									
		1	2	3	4	5	6	7	8	9	10
1930	1	1	1	1	1	1	1	1	1	1	1
1931	0	0	0	0	0	0	0	0	0	0	0
1932	1	1	1	1	1	1	1	1	1	1	1
1933	6	6	4	3	3	3	3	3	2	2	2
1934	2	2	1	0	0	0	0	0	0	0	0
1935	1	1	1	1	1	1	1	1	1	1	1
1936	2	2	2	2	2	2	2	2	2	2	2
1937	1	0	0	0	0	0	0	0	0	0	0
1938	2	2	1	1	1	1	1	1	1	1	1
1939	5	4	4	4	4	4	4	4	4	4	4
1940	3	2	2	2	2	2	2	2	2	2	2
1941	1	1	0	0	0	0	0	0	0	0	0
1942	6	3	3	3	3	3	3	3	3	3	3
1943	6	6	6	6	6	6	6	6	6	6	6
No cases	37	31	25	24	21	16	14	13	11	10	8
No living		25	17	15	13	9	8	8	4	4	4
Per cent		81	68	62	62	56					

lowed by irradiation. In 2 cases treatment was by orchiectomy, Hinman's type of dissection, and irradiation. One of the 2 patients survived ten years and when last heard from, in October 1943, had no evidence of recurrence. The other survived

two years Of all those with seminomas, 56 per cent survived five years or more

To show the radiosensitivity of seminomas we cite the following case

W K, aged 48, was examined at the University Hospitals on Jan 26, 1943 When he was first seen by his physician, in September 1942, his complaints were swelling of the right testicle, first noticed in July 1942, backache, nausea, a feeling of fullness, 30 pounds weight loss, and weakness A diagnosis of right hydrocele was made and surgery was advised

On Nov 10, 1942, the patient was operated upon A tumor was then discovered in the right testicle, and a simple orchietomy was performed The histologic diagnosis was seminoma

On Jan 26, 1943, the patient came to the University Hospitals for x-ray therapy He appeared well developed but emaciated No lymph nodes were palpable The upper mediastinum seemed to be widened There were dullness, diminished breath sounds, and increased fremitus at the base of the right lung posteriorly The heart was slightly enlarged to the left, and there was a loud systolic murmur at the apex

There was a large hard mass in the epigastrium measuring about 10×14 cm, extending below and to the right of the umbilicus The mass was fixed posteriorly The liver and spleen were not palpable There was some shifting flank dullness Prominent veins were seen extending up over the abdomen to the chest No peripheral edema was observed A draining sinus was seen in the right scrotum, and the right testicle was absent

The laboratory findings were as follows urine negative, hemoglobin $10 \pm$ gm, leukocytes 5,280 (89 per cent neutrophils, 7 per cent lymphocytes, and 4 per cent monocytes)

A film of the chest showed marked elevation of the right diaphragm, which, it was believed, might be due to the large abdominal mass (Fig 1)

A review of the section from the removed tumor verified the diagnosis of seminoma of the testis

Irradiation was directed to the abdominal mass and 2,200 r in air were given to each of two fields, one anterior and one posterior This series of treatment was started on Jan 26, 1943, and completed Feb 24, 1943 The mass was quite resistant to irradiation and receded very slowly The patient was then given a ten day period of rest so that he might recuperate from the effect of irradiation He was to return for examination and further treatment if needed He did not report back, however, until May 5, 1943 Examination now showed a palpable left supraclavicular node and extensive metastases in the mediastinum (Fig 2) There had been a gain of 12 pounds in weight

Irradiation was again instituted, and 1100 r in air were given to each of two fields, anterior and posterior, to the mediastinum, and the left supraclavicular region, being completed in fourteen days



Fig 3 Roentgenogram of the chest made Oct 26 1944 This is one of a number of examinations made between July 8, 1943 and Nov 8 1945 in all of which emphysematous lungs without evidence of metastases or other lesions aside from the scar in the left upper lobe were shown Note the complete absence of any sign of the enlarged lymph node masses observed prior to radiation therapy (Report by L Rigler)

An x ray film on July 8, 1943, was negative and subsequent x ray examinations revealed no recurrence of metastases in the mediastinum or lungs (Fig 3) There was no palpable mass in the abdomen at the last examination, Nov 8, 1945

The patient returned to his former occupation in the summer of 1943 He regained his normal weight and remained in good health until December 1945 We have been informed that his condition suddenly became serious and that he expired Dec 29, 1945 Autopsy could not be obtained

2 *Carcinomatous Mixed Tumors* (Table II) There were 29 patients in this group Twenty-five had metastases when irradiation was begun Only one patient survived five years This group is radio-resistant and in our experience irradiation is of little value

3 *Unclassified Group* (Table III) The unclassified group consisted of 34 cases In 28 of these a microscopic diagnosis of malignant tumor was made A clinical diagnosis was made in 6 cases Twenty-four patients in this group had metastases at the beginning of treatment Six with extensive metastasis had no operation but

TABLE II TWENTY-NINE CASES OF PROVED CARCINOMATOUS MIXED TUMORS OF THE TESTIS

Year	No of Cases	Years of Survival						
		1	2	3	4	5	6	
1926	1	1	1	0	0	0	0	
1927	0	0	0	0	0	0	0	
1928	0	0	0	0	0	0	0	
1929	2	0	0	0	0	0	0	
1930	0	0	0	0	0	0	0	
1931	0	0	0	0	0	0	0	
1932	3	1	1	0	0	0	0	
1933	2	1	0	0	0	0	0	
1934	1	0	0	0	0	0	0	
1935	2	1	0	0	0	0	0	
1936	2	1	0	0	0	0	0	
1937	3	3	3	1	1	1	1	
1938	3	1	0	0	0	0	0	
1939	1	1	0	0	0	0	0	
1940	2	1	0	0	0	0	0	
1941	3	0	0	0	0	0	0	
1942	2	0	0	0	0	0	0	
1943	2	0	0	0	0	0	0	
No cases	20	27	25	22	20	19	16	
No living		11	5	1	1	1	1	
Per cent		41	20	5				

were irradiated, none of these patients survived five years

Twenty-nine per cent of the unclassified group were alive after five years. It is likely that many of these cases were actually seminomas.

Entire Series In all, 65 patients with malignant testicular tumors were treated more than five years ago. Of these patients 18, or 29 per cent, survived five years or more.

Hinman has made the statement that the metastatic lesions from one type of testicular tumor may show the structure of another type and that classification, therefore, is of limited value. Though such changes may occur, they have not been encountered in this series, and the response to treatment has followed the predictions closely. We have not encountered any carcinomatous mixed tumors which were favorably influenced by x-ray therapy. The seminomas, on the other hand, consistently responded to irradiation, and some of the patients with distant metastases became free from symptoms and have remained well up to the present time. It therefore seems that Bell's classification is useful if carefully followed. We wish here to express our gratitude to Dr. E. T. Bell and Dr. J. S. McCartney for their willing-

ness to re-examine the slides and thus make it possible for us to obtain reliable correlation between the specific types of malignant testicular tumor and the results of treatment.

TABLE III THIRTY-FOUR UNCLASSIFIED CASES OF MALIGNANT TUMORS OF THE TESTIS

Year	No of Cases	Years of Survival										
		1	2	3	4	5	6	7	8	9	10	
1926	1	1	0	0	0	0	0	0	0	0	0	
1927	1	1	0	0	0	0	0	0	0	0	0	
1928	0	0	0	0	0	0	0	0	0	0	0	
1929	3	1	0	0	0	0	0	0	0	0	0	
1930	2	0	0	0	0	0	0	0	0	0	0	
1931	1	1	0	0	0	0	0	0	0	0	0	
1932	4	1	1	1	1	1	1	1	1	1	1	
1933	0	0	0	0	0	0	0	0	0	0	0	
1934	4	4	1	1	0	0	0	0	0	0	0	
1935	4	2	1	1	1	1	1	1	1	1	1	
1936	3	3	3	2	2	2	2	2	2	2	2	
1937	2	2	2	2	2	2	2	2	2	2	2	
1938	3	3	2	2	2	2	2	2	2	2	2	
1939	2	2	2	2	2	2	2	2	2	2	2	
1940	2	0	0	0	0	0	0	0	0	0	0	
1941	2	2	2	2	2	2	2	2	2	2	2	
1942	0	0	0	0	0	0	0	0	0	0	0	
1943	0	0	0	0	0	0	0	0	0	0	0	
No cases	34	34	34	32	30	28	25	23	20	16	12	
No living		23	14	11	10	8	6	4	2	1	0	
Per cent		68	41	34	33	29	24					

CONCLUSIONS

1 Tumor of the testis is frequently found in patients with hydrocele.

2 As in all malignant tumors, early diagnosis is of utmost importance.

3 A differential diagnosis should be made (histologically) so that each testicular tumor can be classified correctly.

4 Seminoma is a malignant tumor which forms metastases rapidly.

5 Seminomas of the testis are radio-sensitive. The patient should have the benefit of x-ray therapy regardless of the stage of metastasis present.

6 There should be no delay in instituting irradiation following simple orchiectomy.

7 Frequent follow-up examinations should be done.

8 Simple orchiectomy followed by irradiation is the treatment of choice in seminomas.

9 The carcinomatous mixed tumors should be treated by radical dissection, and adult teratoma by simple orchiectomy.

SUMMARY

1 An analysis has been made of 100 cases of malignant tumor of the testis seen at the University of Minnesota Hospitals from 1926 to 1943 inclusive

2 Bell's classification of malignant testicular tumors has been used in this report. According to this, the group consisted of 34 unclassified cases, 37 seminomas, and 29 carcinomatous mixed tumors

3 For seminomas the age incidence was slightly higher than for carcinomatous mixed tumors

4 Metastasis was known to be present before irradiation was started in 65 per cent of the seminomas, 86 per cent of the carcinomatous mixed tumors, and 70 per cent of the unclassified group

5 Therapy consisted of simple orchectomy and irradiation in 90 cases, irradiation alone in 6 advanced cases, and Hinman's operation and irradiation in 4 cases

6 Results of therapy can be summarized as follows. In seminomas of the testis the five-year survival rate is 56 per cent. In the carcinomatous mixed tumor group only 1 patient survived five years, while in the unclassified group, 29 per cent survived five years. If all the patients with malignant testicular tumors are considered together, a five-year survival rate of 29 per cent was obtained

7 There were 4 cases in which the combination of Hinman's dissection and irradiation was used, with one five-year survival. Six advanced cases were treated with irradiation alone, with no five-year survival

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Fig 2 Lateral projection The instrument is 2 inches below the cardia, the tip gliding on the posterior gastric wall The duodenum filled with gas is located behind the posterior wall A Posterior wall of stomach along which the tip of the gastroscope is gliding B Gas in duodenum and jejunum pressing lower portion of stomach anteriorly

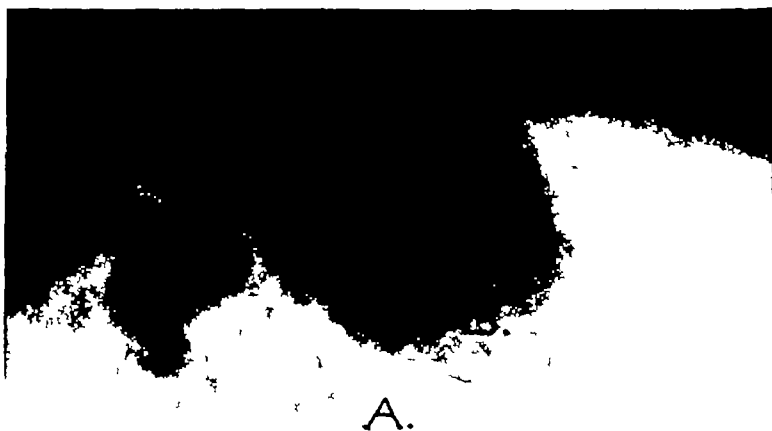


Fig 3 Lateral projection A Posterior wall on which the instrument is resting B Edge of angularis seen around the dark cavity of the antrum Compare with Fig 7

strated that there was a considerable amount of air distending not only the stomach but the duodenum and upper small intestine as well. This surprising amount of air in the small bowel, increasing in volume as the examination progresses, pushes the stomach anteriorly and may in some instances distort its lower pole considerably (Figs 2 and 3). These effects of distention are, no doubt, the reason why

in another instance it glided along the posterior wall almost immediately after passing the cardia (Figs 2 and 4). This second situation would result in a large blind area on the posterior wall because of the inadequate focal distance,³ while if the instrument fortuitously failed to engage the posterior wall until the lower depth was reached, the bulk of the upper posterior wall could be seen



Fig 4 Lateral projection A Tip of gastroscope just meeting the posterior wall of the stomach, in spite of the instrument being close to the antrum. Compare with Fig 2 where the gastroscope is seen impinging on the posterior wall soon after passing the cardia

inexperienced gastroscopists, when they introduce air too rapidly, fail to visualize the pylorus

In the study of the gastroscopic blind areas, an interesting and important point observed is the variation in the relationship of the instrument to the posterior wall, due to different types of body habitus. In one case the gastroscope reached the lower third of the stomach before it impinged on the posterior wall (Fig 3), while

A second so-called blind area for gastroscopists is the lowermost lesser curvature, which is hidden by the angulus, even when the pylorus is fully visualized. This zone varies with the angulation of the antrum and body of the stomach and, as noted pre-

³ Some of the difficulty in visualizing mucosal areas too close to the gastroscope seems due in part to the fact that the light source is separated from the objective. The field therefore becomes dark, not due to inadequate focal distance *per se* but rather because the objective is outside the cone of light of the lamp

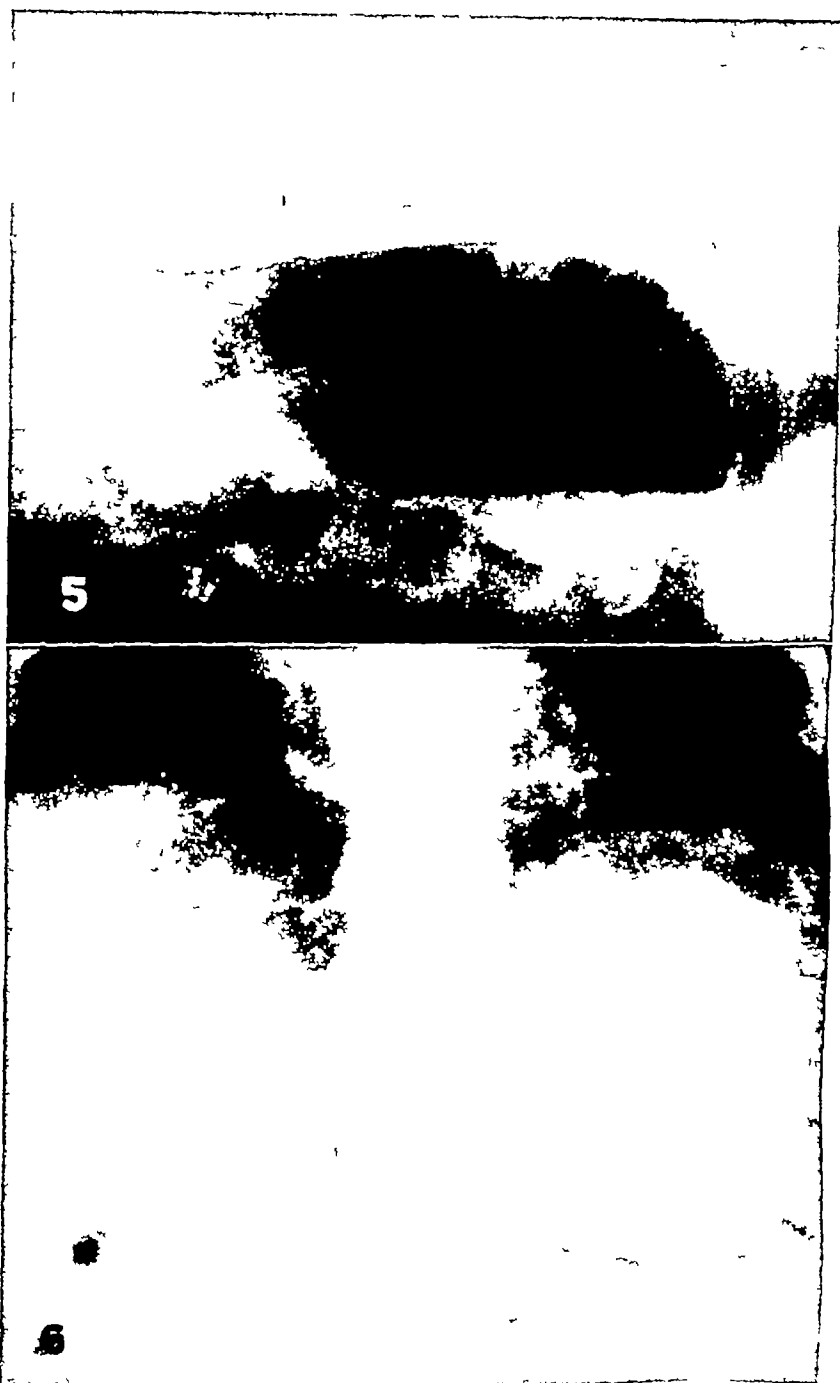


Fig 5 Anterior-posterior projection Gastroscopist at full insertion with stomach completely dropped to the left of the spine A Angulus seen at edge of antrum B Polypoid carcinoma dimly outlined in antrum

Fig 6 Anterior posterior projection Marked persistent deformity of pyloric antrum due to carcinoma (same patient as Fig 5)

viously, by the amount of air introduced into the upper bowel. Respiratory movements and peristaltic waves, however, may transiently bring portions of the mucosa into view from behind the angulus.

The fundus of the stomach cannot be seen at gastroscopy simply because no retrograde vision is possible. The films suggest that this area may be increased in extent by over-distention of the stomach, causing more of the fundus to dome above the cardia.

Even with this medium of little weight the stomach is seen to pass well across the spine to the left, or lowermost, side of the body (Figs 5 and 6). This extensive mobility may well be significantly reduced in cases where perigastric inflammatory or neoplastic infiltration and adhesions have fixed the stomach. Roentgenologic studies might prove this to be a differential point of importance, for it is known, for instance, that when the pylorus is seen abnormally far posteriorly on gastroscopy, the presence of a penetrating duodenal ulcer is suggested.

The medium was satisfactory under ordinary fluoroscopic conditions. However, because the stomach was distended with air, and because this material settled and pooled in the most dependent portion, our medium was of little help in demonstrating details of the gastric mucosa. On the other hand, the air tended to make the cavity of the antrum visible (Figs 3 and 7), and in one case even the ligament of Treitz was recognizable (Fig 8).

COMMENT

This study suggests that the zones visualizable at gastroscopy could be increased by a slight change in the instrument. If the source of light were not separated from the objective, the angle of vision and the cone of light would more nicely coincide. This, we feel, would make it possible to see more of the posterior wall. The new omni-angle gastroscope, by allowing the angulation of the objective to be shifted at will during an examination, has somewhat re-

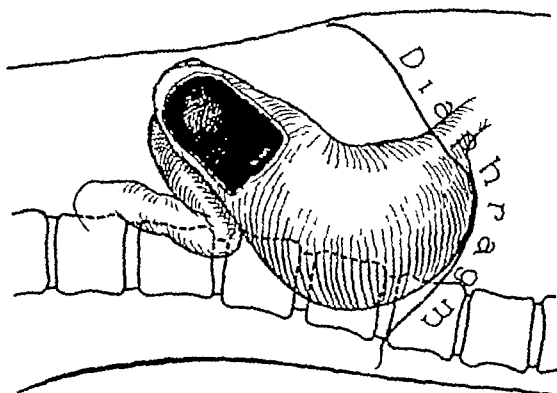


Fig 7 Diagrammatic sketch of a lateral view of the stomach, revealing the recession of the cavity of the pyloric antrum toward the duodenum. Compare with the antral cavity in Fig 3.

duced the extent of the areas hidden behind the angulus and near the cardia.

The methyl cellulose-diodrast mixture, with the usual relief methods, gave satisfactory results. Since this medium does not distort the stomach by its weight, a complete investigation of the limitation of gastric mobility in disease may be very profitable. Neoplasms confined to the stomach may not prevent the organ from shifting across the spine (in the left lateral position), while if extension to surrounding structures has occurred, the orientation of the stomach in the abdominal cavity may be restricted. Perigastric fibrosis and inflammation due to duodenal or gastric ulcers may reduce gastric mobility, which we have shown to be quite extensive with the patient turned on his side. This method would have real clinical value if, thereby, radiologists could inform surgeons that a pathologic process had extended beyond the stomach.

SUMMARY

- 1 The appearance of the gastric mucosa was studied by means of simultaneous radiographic and gastroscopic examination.
- 2 A contrast medium composed of equal parts of diodrast and a saturated aqueous solution of methyl cellulose was found to be satisfactory for mucosal relief studies.
- 3 Certain factors which influence the

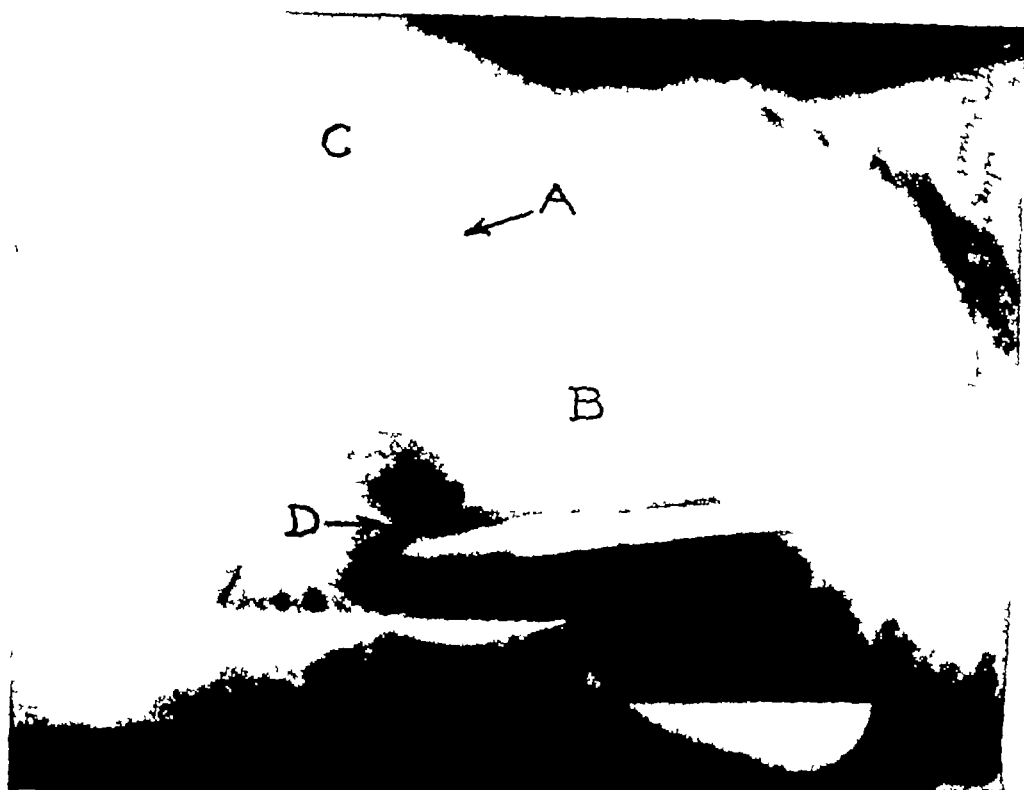


Fig 8 Anterior posterior projection Gastroscope at mid insertion The diodrast mixture has pooled at both levels of the cascade stomach A Pyloric sphincter B Diodrast mixture in duodenal cap C Gas-filled second portion of duodenum D Ligament of Treitz

extent of the gastroscopic blind areas were shown

4 The extensive mobility of the stomach was demonstrated

5 Study of a sign which may indicate perigastric disease was suggested

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Malignant Melanoma in Infancy

Report of Three Cases¹

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ALTHOUGH moles are frequently present at birth or become discernible shortly thereafter, malignant melanomas are rarely encountered at so early an age. Malignant tumors most frequently seen during the first five years of life are retinoblastomas, renal tumors (Wilms), and neuroblastomas of the adrenals or sympathetic

quiescent lesion. Only a small percentage of melanomas ever become malignant. It is, however, a well recognized fact that this type of lesion may undergo malignant change, especially when located where it is continuously exposed to irritation or trauma. In children this predisposing factor is insignificant, and hormonal stimu-



Fig 1 Case I Congenital malignant melanoma

nervous system, usually in the order mentioned (5). Other malignant neoplasms, including the melanomas, constitute only a small percentage of the total.

Melanomas, as indicated above, may be present at birth, or they may make their appearance at any time during life. Many are first noticed shortly after puberty. It is doubtful that a nevus first recognized later in life is of recent origin, it is probably due rather to growth of a previously

lution has been suggested by some authorities as playing an etiologic role.

The neval cells are melanoblastic and may or may not produce the pigment melanin. The embryological origin of these cells lies beyond the scope of this paper. They may be of neuro-tissue derivation, in which case the melanoma is superficially located, on the skin. The more deeply situated growths arise in mesoblastic connective tissue, are sarco-

¹From the Department of Radiology, University Hospitals, Oklahoma School of Medicine, Dr. John E. Heatley, Director. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.



Fig 2 Case I Metastases in femurs and pelvis

matous in nature, metastasize by way of the blood stream, and are more rapidly fatal

The three cases to be reported presented both diagnostic and therapeutic difficulties. Other points of interest will be brought up in the discussion following each case history.

CASE I A white male infant five weeks of age was brought to us on May 31, 1944, because of numerous nodules present over its body. The mother stated that the tumors were present at birth, April 24, 1944. Since that time, several new lumps had appeared, while one or two of the others had become smaller.

Delivery had been normal. The family history was negative for tuberculosis, syphilis, and malignant neoplasms. Two other children had been normal up to the time of death by accident.

Examination revealed normal development and marked pallor of the skin. Most remarkable were the numerous masses distributed over the entire surface of the body, varying from one to several centimeters in diameter (Fig 1). Some appeared to involve the skin, having a purplish red color, others were more deeply situated and were covered by normal appearing skin. The consistency was rather

firm, and the deeper tumors were firmly fixed to the surrounding tissues. The scrotum and prepuce were swollen and edematous, as was the left lower extremity. The lymph nodes of the left inguinal region were enlarged and were fixed to the underlying tissues.

A clinical diagnosis of malignant melanoma was made and the child was admitted to the hospital for further studies.

Laboratory findings were as follows: *Urine*, specific gravity 1.008, cloudy, acid, with trace of albumin but no sugar. *Blood*, hemoglobin 7.5 gm., red cells 2,160,000, white cells 15,150 (neutrophils 48 per cent—stab cells 7 per cent, juvenile forms 3 per cent—lymphocytes 45 per cent, monocytes 5 per cent), anisocytosis and poikilocytosis, 65 nucleated red cells per 100 white cells counted, Kahn test negative.

Roentgenographic examination made on the date of admission revealed destructive bony lesions involving the lateral aspects of the distal metaphyses of both femurs, with little evidence of bone reaction. Films of the chest, skull, and other bones showed no changes. In their symmetrical distribution and location, the lesions were not unlike those seen in congenital syphilis of bones. *Impression*, Osteolytic metastases (Fig 2). Repeated roentgen study two weeks later showed similar destructive lesions involving the left radius, ulna, and ischium.

A nodule overlying the sternum was excised and examined microscopically. Dr. Béla Halpert reported it as showing "sheets and nests of cells with large vesicular, deeply stained nuclei—their cytoplasmic borders are indistinct. Some of the cell nuclei are in a state of division. The neoplastic growth invades and replaces adipose tissue." *Diagnosis*, Malignant neoplasm, probably melanoma.

The patient's general condition grew progressively worse and he died on June 15, 1944, two weeks after admission. Permission for necropsy was not granted.

Discussion This undoubtedly is a case of a congenital malignant neoplasm, since evidence of metastasis was present at birth. We were unable to determine the exact origin of the tumor, and it is doubtful that this could have been ascertained even by a careful necropsy because of the wide spread distribution of metastases at the time of death. Special attention was given to examination of the eyes to rule out retinoblastoma, since this is the most common form of malignant tumor present at birth. No intra-abdominal masses could be detected by palpation or by any other method of examination. H. G. Wells (5), in his excellent article on *Congenital Malignant*

Neoplasms, says that, "although pigmented moles are frequently present at birth, they rarely become malignant before birth or even in infancy." In his extensive review of the literature, he encountered only four such cases that he believed could be considered authentic, those of Coe, Reinmann, Dudits and Szabó, and Krompecher. In all, he found only 66 authentic and acceptable cases of congenital malignant growths, to which he added 4 of his own: 3 cases of adrenal neuroblastoma and 1 case of neuroblastoma of the sympathetic nervous system.

Of our cases, Case I is the only one in which a correct clinical diagnosis was made. The child expired on the day we had decided to see what effect, if any, stilbestrol would produce.

CASE II An Indian girl, three years of age, had been seen on numerous occasions and treated for the past two years for upper respiratory infections and clubfoot. On her last visit to the Orthopedic Out-patient Department, April 8, 1943, a small tumor of the scalp over the right frontal area was observed. This nodule had first appeared only six weeks previously but had rapidly grown larger so that it was about the size of a small olive.

The consistency of this mass was firm but not hard and it measured approximately 2×2.5 cm. and was elevated about 1.5 cm. The overlying skin contained a few dilated capillaries, but no pigment. No superficial adenopathy could be detected. Clinically the nodule was thought to be a sebaceous cyst, and the child was admitted to the hospital for its excision.

Laboratory findings were as follows: *Urine* specific gravity 1.026, no albumin or sugar. *Blood* hemoglobin 12 gm., red cells 3,740,000, white cells 8,100 (48 per cent neutrophils, 52 per cent lymphocytes), Kahn test negative.

The nodule was widely excised and prepared for microscopic examination. Dr. Béla Halpert reported the tissue as showing "sheets of epithelial cells with round and elongated large vesicular nuclei of almost even size, and with hardly any discernible cytoplasmic borders, little or no connective tissue stroma is seen. Some cell nuclei stain deeply and some are in a state of division. Areas of necrosis are seen here and there. There is an infiltration by these cells of the fibrous connective tissue. About these areas are large mononuclear cells with golden yellow granules in their cytoplasm." *Diagnosis*: Neoplasm, probably malignant, probably epithelial.

X-ray films of the skull and chest taken at this time were reported as showing no evidence of any pathologic change.

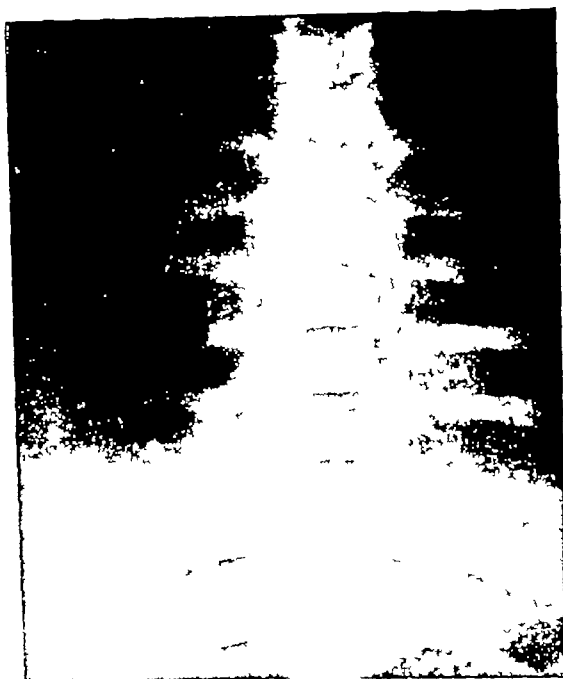


Fig 3 Case II Metastases in 9th thoracic vertebra, with soft-tissue paravertebral shadow

The patient was discharged only to be readmitted on Aug. 17, 1943, four months later, suffering from an attack of acute tonsillitis. Enlarged lymph nodes present at both angles of the jaw were thought to be due to the throat infection. The patient was again discharged after a few days, apparently in good condition. When seen again, one month later, she had a stiff neck and paralysis of both lower extremities, incontinence of feces and urine, and exophthalmos of the left eye. Because of the severe poliomyelitis epidemic, that disease was suspected. On more thorough examination, it was found that the nodes on the right side of the neck were enlarged, firm, and fixed. Films of the skeleton revealed destructive lesions involving the 5th lumbar vertebra and left sacroiliac joint, the sacrum, both iliac bones, the upper ends of the femurs, and the 9th dorsal vertebra (Figs 3 and 4). Chest films were negative for pulmonary metastases.

The child died Sept. 11, 1943, less than six months after the onset of the disease.

Necropsy revealed gross metastases to the lungs, kidneys, liver, pancreas, suprarenals, thymus, abdominal lymph nodes, spine, and skull. *Final Diagnosis*: Malignant melanoma.

Discussion In this case a malignant growth was not suspected until microscopic examination of the tissues was done. In spite of early excision of the mass, only six weeks after the period of onset, metastasis had already taken place. Careful

and repeated examinations of the eyes failed to reveal any evidence that the original site of the tumor was intra-orbital. Dargeon (1) states that pigmented malignant melanomas in early life are usually slow-growing tumors and metastasis occurs late. The non-pigmented malignant nevus, however, is usually fast-growing and runs a rapid course. From these cases it appears that these tumors conform to their behavior when occurring later in life, in

uloma pyogenicum was made and the patient was admitted to the hospital for treatment.

Laboratory findings were as follows: *Urine* Specific gravity 1.020, no albumin or sugar. *Blood* hemoglobin 73 per cent, red cells 3,870,000, white cells 4,500 (neutrophils 52 per cent, lymphocytes 47 per cent), sedimentation rate 92 per cent (Westergren), Kahn test negative.

The lesion was widely excised and the skin edges were closely approximated and sutured. The wound became infected, however, and it was then noticed that a lymph node in the left inguinal region had become swollen.

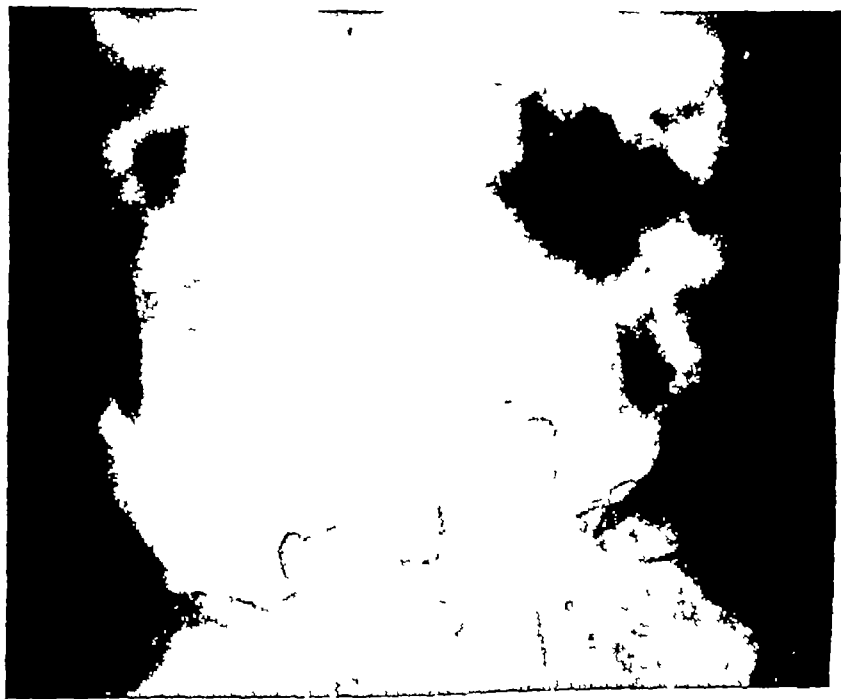


Fig 4 Case II Metastases in pelvic bones

that they vary in rate of growth and degree of malignancy.

CASE III A 3 year old colored girl was first seen on Dec 3, 1941, for a skin lesion of the left knee. The mother informed us that a small nodule first became noticeable about one year earlier and had caused no concern until about a month ago when it began to grow larger and bled on several occasions. When first seen by us, the lesion was about 2 cm in diameter and elevated over 1 cm. It was located on the lateral aspect of the left knee. The skin over this area was ulcerated and its surface was covered with a grayish exudate. The consistency of the mass was rather soft and no enlarged nodes were palpable in the left inguinal region. The general condition was good. A clinical diagnosis of gran-

ulosa pyogenicum was made and the patient was admitted to the hospital for treatment. Tissue specimens were examined by Dr. Hugh Jeter, who reported them as showing "pigmented skin with a comparatively large ulcerated area. At the margin of the ulcer and in the base of the ulcer, there are streams, masses, cords and irregular groups of poorly differentiated cells, some definitely in continuity with the basement cells of the epidermis. Portions are moderately vascular. Stroma is scanty. Unable to definitely identify melanotic pigment."

Diagnosis (1) Malignant tumor, probably amelanotic melanoma, (2) ulcerative inflammation. Since we were unable to determine definitely whether the enlarged inguinal node was of an inflammatory or malignant nature, it was decided to give a very moderate amount of deep x-ray therapy: 1200 r in air (170 kv, 20 ma, 50 cm distance).

Thoraeus filter) were given in daily doses of 200 r. With healing of the incision, the patient was discharged from the hospital. She was not seen again until March 4, 1942, about three months later. Although the primary site of the lesion had completely healed, the lymph node in the inguinal area had enlarged to twice its previous size. The involved lymph node was removed, and ligation and section of the left saphenous vein were performed. Microscopic examination of the tissue showed invasion and replacement with tumor cells resembling those described as occurring in the original lesion. Additional deep x-ray therapy over the left inguinal area was given, similar in amount to the previous series. This patient has been closely followed for over three years and careful physical and radiographic examinations have failed to show any evidence of recurrence or metastases.

Discussion In this case as in the previous one, a malignant lesion was not suspected until microscopic examination was done. In contrast to Case II, the nodule of the skin had been present for over one year and had grown to five times its original size in the last month. A metastatic node was permitted to remain unmolested for three months because the mother was satisfied with the appearance of the original site of the lesion. Surely this must have been a very slow-growing type of non-pigmented malignant melanoma. It will be interesting to follow this case further to see what the final outcome will be. In none of the cases recorded here were we able to obtain a history of malignant neoplasms in the family, although the second patient came from an orphanage and no family history was available. The last case has an added interest in that it occurred in a colored patient, since this type of malignant neoplasm is seldom found in the American Negro.

COMMENTS

Malignant melanomas are rarely encountered in the first five years of life and are very rarely seen as congenital lesions. Kellert in a series of 15 malignant tumors in children (2), and Scotti (4) in 64 cases, found not a single instance of malignant melanoma. Ritvo's series (3) of 72 cases

included 2 examples, in girls 14 and 11 years of age, respectively. Our experience of seeing three cases within a short period of time, all in very young children, is unusual.

In our second case, a pigmented malignant melanoma, though discovered and treated early, ran a rapid fatal course. In the third case, a non-pigmented malignant melanoma has shown all the characteristics of a slow-growing, late-metastasizing growth, and the patient after five years is without evidence of any recurrence or metastases.

Since the final diagnosis eventually must be made on the microscopic examination of the tissue removed, all suspicious appearing lesions should be treated by wide excision.

SUMMARY

Three cases of malignant melanoma are reported: one congenital and the other two occurring early in life.

Microscopic examination of the lesion was necessary in two cases to reveal the true nature of the disease. In one case, the diagnosis was made clinically and confirmed by biopsy.

A non-pigmented malignant melanoma, occurring in a colored child, shows no evidence of recurrence or metastasis five years after excision of the primary tumor and a single metastatic lymph node, with subsequent deep x-ray therapy.

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The "Last-Straw" Factor in Low Back Disability¹

With Summary of 100 Cases Examined and Evaluated by the Medical Advisory Board of the Industrial Commission of Arizona, 1934-1943

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IN A PERIOD OF nine years, 1934-1943, the Medical Advisory Board of the Industrial Commission of Arizona examined over 600 patients, among whom were 106 with disability of the low back as the chief or only complaint. This period has been chosen for the present report because during these years the writer served on the Board as consulting radiologist and secretary. In the latter capacity, it was his duty to record the historical data, the patient's complaints, the physical, clinical, laboratory, and x-ray findings, and the final conclusions of the Board for each case.

For this paper, the records of all patients with lower back disability have been reviewed. After excluding 6 cases showing fracture, neoplasm, or destructive bone disease, there remain 100 as a basis for the comments and conclusions to be presented. These 100 patients have been classified as follows, on the basis of the roentgen findings:

No visible bone injury or abnormal joint condition	42
Visible bone or joint changes	33
Developmental anomalies, with or without bone changes	25

The 42 cases without visible changes in bones or joints were evaluated as follows:

No symptoms from injury or symptoms ended	25 (59.5%)
Hysteria, neurosis, or malingering	4
Evidence of disability	14*
Rated at 5% general disability	4
Rated at 10% general disability	5
Rated at 15% general disability	1
Rated at 25% general disability	1
Rated at 30% general disability	1
Total disability	2*

* One of these was in the hysteria group.

While the cases without visible bone or joint changes are not being discussed in this paper, it is significant that the percentage of this group presenting symptoms which in the final evaluation by the Board were regarded as not attributable to the injury (59.5 per cent) approximates closely the percentage (57 per cent) classified by Johnstone (1), in a study of 3,000 cases of lower back "sprain", as not due to injury or not arising out of employment.

Here we are concerned chiefly with those cases in which there were demonstrable bone or joint conditions of an abnormal or anomalous character. There were 58 of these. Thirty-three of the patients showed arthritis of some type, of varying degree, with evaluation by the Board as follows:

No disability from injury in question	15
Evidence of disability from injury in question	18
5% general disability	4
10% general disability	10
15% general disability	1
20% general disability	1
50% general disability	2

Of the remaining 25 patients, showing developmental anomalies in the lower back, practically all had an associated osteoarthritis. Evaluation in this group was as follows:

No disability from injury in question	11
Disability from injury in question	14
5% general disability (or less)	2
10% general disability	5
15% general disability	2
20% general disability	3
35% general disability	1
65% general disability	1

There was no question in the estimation of the Board that in the 58 patients with abnormal bone or joint conditions painful

¹ Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10 1945

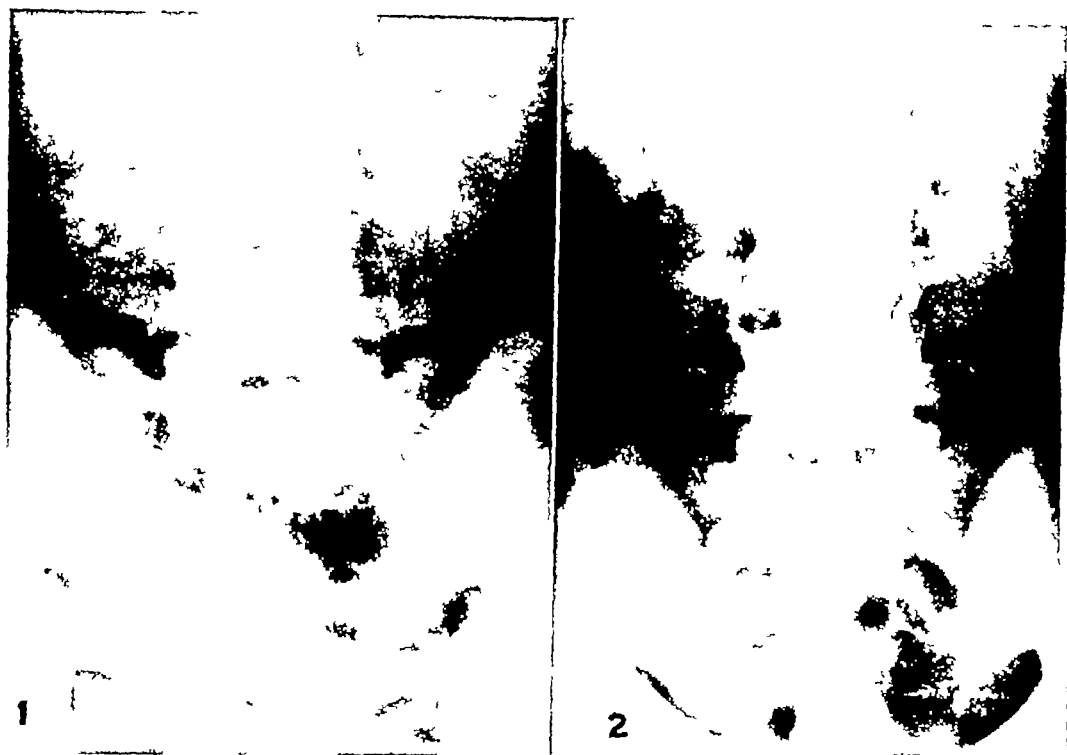
symptoms developed during employment, but in 26, or nearly half the group, the decision was that the disabling symptoms could not be attributed to injury. It is in defense of these conclusions by the Medical Advisory Board, and of similar decisions by individual consultants and other consulting boards, that this paper is presented. The need for such a rationalization may be judged from the fact that one of these patients brought suit against the Medical Advisory Board, the charge being fraud for knowingly making a decision of "no disability from the injury in question" when it must have been known there was disability from the injury. A jury verdict of \$6,000.00 was obtained against the Board but was later reversed by the Supreme Court of the state.

The rationale of the Board's decisions in many of these difficult cases rests on the broad and sound biologic principle of adaptation, which is one of the fundamental life properties and perhaps the underlying principle of all life activity. Adaptation enables the cell or organism to survive unfavorable conditions and, therefore, underlies most medical practice. In clinical medicine we attempt to change unfavorable conditions and thus enable the organism to survive a danger, but most of our medication aims to lend aid to the adaptive or compensatory powers of the body. In many of our most serious diseases all that the clinician can hope to do is to assist the organism to adapt itself to the presence of a pathological process and live with it, and in spite of it, as long as possible.

The adaptive processes themselves may under certain conditions become disabling, as when external stresses are too suddenly applied, as in the nervous collapse of overwork or too rapid military training. Industry also has its casualties of this type, and these have been greatly multiplied by the necessity for using thousands of people in tasks for which they have not had adaptive training of muscles or joints. When adaptive changes take place in some vital structure or tissue, general damage may result, a good example is that form of

malignant hypertension due to constriction of the renal arteries, where a high blood pressure needs to be maintained in the whole arterial circulation in order to push the blood through the narrowed renal vessels.

The effort at adaptation may be at the expense of other tissues or organs, as in the halstheresis found in many conditions. The generalized decalcification of senescence is common, and many cases of disability are being seen due to the war-time necessity for older people to engage in occupations which required unaccustomed stresses on the bony framework. Most of the tissue changes of senescence are adaptive in character and, under normal conditions, the habits of life can be so adjusted that they take place gradually and health is maintained. The senescent decalcification of the vertebral bodies, found normally after middle life, may furnish a good example of a "last-straw" factor breaking an adaptive process. The lateral view of a senescent spine will show evidences of adaptive change. The vertebral bodies will have a "washed-out" or low-density appearance, due to loss of calcium, there will be a compensatory expansion of the disk cartilages, the cortices of the bone adjacent to the disks will retain calcium or new calcium will be deposited, in the longitudinal or lateral ligaments, or at their attachments to the vertebrae, compensatory hypertrophic spurs may develop. All of these changes are but the effort of the organism to compensate for the loss of support brought about by the calcium removal. If, in such cases, the process of adaptation does not keep pace with the demands thrown on the spine, the time often comes when a last straw of stress may literally "break the camel's back." Spontaneous collapse of vertebrae is often observed in the senescent spine attributable solely to this last straw. Practically all of the changes in chronic hypertrophic arthritis of the spine and those observed in connection with developmental anomalies at the lumbosacral area are adaptive in character, and in



Figs 1 and 2 Case III Infectious arthritis of the sacroiliac joints Claim of low back pain due to trauma Ruled not compensable. Fig 1 is a reproduction of a film made Feb 11, 1937 Fig 2, Jan 10 1939, shows further extension of the infectious arthritis nearly two years later See also Fig 3

them the last-straw factor plays an important part in the development of symptoms

In order to give intelligent consideration to the abnormal bone and joint changes found in the lower back, with or without associated developmental anomalies, it is necessary to resolve the confusion that exists with regard to arthritis, using the term in a very general sense, as it concerns the lower back Up to the present, probably the most authoritative classification of arthritis is that of the American Rheumatism Association In their first annual review, in 1935 (2), the Committee on the Control of Rheumatism set up a classification which has been only slightly modified since The classification officially adopted by the Association, as given in the most recent review (3), groups all forms of rheumatism and arthritis under nine headings

- 1 Specific infectious arthritis (organism known)
- 2 Arthritis of rheumatic fever

- 3 Arthritis of immediate traumatic origin
- 4 Rheumatoid arthritis (synonyms atrophic arthritis, proliferative arthritis, chronic non specific infectious arthritis, Still's disease, Marie-Strümpell spondylitis)
- 5 Osteoarthritis (synonyms chronic hypertrophic arthritis, senescent arthritis, degenerative joint disease)
- 6 Arthritis of gout
- 7 Arthritis of neuropathic origin (Charcot joint)
- 8 Neoplasms of the joint
- 9 Miscellaneous forms (or arthritis associated with other diseases)

From this classification, it will be seen that the chronic bone or joint changes found in the lower spine will fall into one or another of three groups

I Chronic bone changes from some specific infection, as tuberculosis, typhoid fever, undulant fever, fungus infection, or pyogenic infection, or from a benign or malignant neoplasm

II Rheumatoid arthritis, known also as chronic infectious arthritis, atrophic arthritis, chronic proliferative arthritis, Marie-

Strümpell spondylitis (or spondylarthrititis), spondylitis ankylopoietica or ankylosing arthritis, Still's disease, Bechterew's spondylitis or arthritis, spondylitis rhizomelica, arthritis deformans

III Osteo-arthritis, known also as hypertrophic spondylitis or arthritis, degenerative arthritis, senescent (or senile) arthritis, spondylosis, osteo-arthrosis

One point of confusion, which deserves special emphasis, is the uncritical use of the terms "proliferative" and "hypertrophic" in the medical literature. The Rheumatism Association's committee stresses the point that the designation "proliferative" should never be used in reference to bone, but always to soft tissues, as synovia, the joint capsule, and ligaments. On the other hand, "hypertrophic" should always refer to bone and never to soft tissues. From the roentgenologic point of view, the most striking difference between Groups II and III is that in rheumatoid arthritis symptoms always precede the development of changes demonstrable on the film, while in osteo-arthritis well developed bone lesions are always apparent before symptoms arise.

Of the 33 patients showing arthritis to a visible degree in the lumbosacral or sacroiliac joints, 5 were classified as having rheumatoid arthritis and 28 as having osteo-arthritis. There were 15 cases in which the Board did not relate the symptoms complained of to injury, either as a causative or aggravational factor. Three of these cases were in the infectious or rheumatoid group. These 3 patients showed variable clinical manifestations.

CASE I Mrs M R, a janitress, aged 48, was moving a desk in order to mop the floor. As she was pushing the desk, in a half stooped position, she felt pain in the lower back. She finished her duties that night, but the next day her back was stiff and she did not return to work but consulted an osteopath. She soon became bedfast from pain, insomnia, weakness, and loss of appetite. X ray examination showed a hypertrophic spur on the fourth lumbar vertebra as the only visible bone change. Eight months later, re-examination revealed visible increase in the size and density of the spur, raising the question of possible traumatic reaction in the spur.



Fig 3 Case III. Typical bamboo spine. Film made March 25, 1941, four years after Fig 1

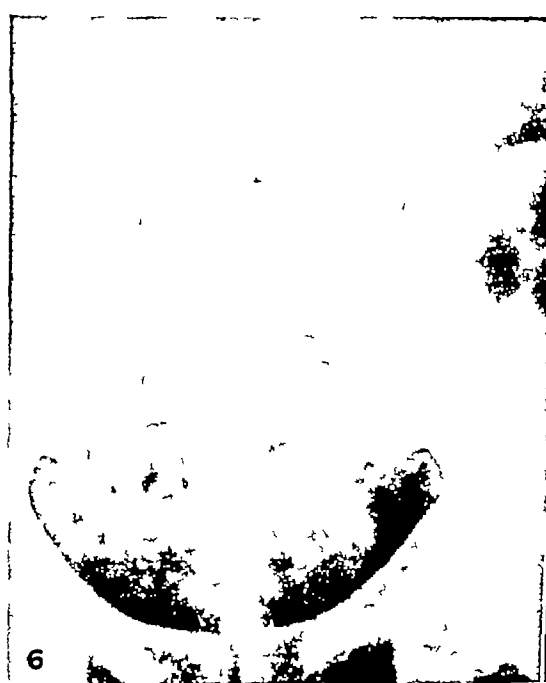
CASE II A workman complained of low back pain, which he claimed was due to his employment. Since no accident could be established, and x-ray examination showed definite sacroiliac changes of infectious arthritis, the Board's decision was that the pain and disability could be fully explained on the basis of the arthritis.

CASE III This patient was so persistent in his claims of disability due to injury that he was repeatedly examined by x-ray over a period of five years. The development of Marie Strumpell arthritis was beautifully shown from the stage of sacroiliac involvement a complete bamboo spine (Figs 1, 2, and 3).

Whenever a workman presents himself for examination or treatment of a low back sprain, with the statement that he has never before suffered pain or disability in his back, and the x-ray films show the bone and joint changes of well established rheumatoid arthritis, the examiner is justified in doubting the patient's truthfulness, since pain practically always precedes the development of visible bone changes. One patient with a completely ankylosed bamboo spine first made this claim but later admitted that he had suffered with stiff-



Figs 4 and 5 Case IV Chronic osteo arthritis with osteosclerosis in the lumbosacral area The lateral view (Fig 5) shows thinning of the disk, which was accompanied by vertical offset in the apophyseal facets shown best in an oblique view



Figs 6 and 7 Case V Extensive lumbosacral osteo-arthritis The lateral view (Fig 7) shows thinning of the disk and hypertrophic spurs on the lumbar vertebrae

ness and pain in the back throughout his youth and that his back "gradually got stiff" He is not included in this report since he had a fracture of the twelfth dorsal vertebra. Another patient—one of the 5 mentioned above—persisted in denying previous back trouble, overlooking the fact that one of the Board members had been consulted by him about a year previously for pain in the lower back not associated with injury.

In osteo-arthritis the hypertrophic bone changes precede the development of symptoms. Very frequently these hypertrophic spurs and bridges may reach astonishingly large proportions without producing sufficient disability to cause the patient to discontinue work, because the adaptive adjustments keep pace with the stresses thrown on the spine. However, the margin of safety is always reduced, and a last-straw factor may break the compensation at any stage in the development of the osteo-arthritic picture.

CASE IV C V S, a 40 year-old mechanic, was fitting a wheel on a car (Aug 23, 1940), being seated with the legs spread. The wheel slipped and jerked him forward, causing pain in the back, which had persisted. Examinations on Feb 3, March 3, and May 26, 1941, showed rather extensive changes in the lumbosacral area, with thinned disk, osteosclerosis, hypertrophic spurs, and other evidence of a slowly developing osteo arthritis (Figs 4 and 5).

Sooner or later such changes will bring on pain and disability, regardless of any back sprain. An entirely normal motion of stress no greater than has been sustained many times before may become a last-straw factor, and pain begins. In the physal joints, the reparative reaction fail to keep pace with the cartilage on, bone becomes exposed, and pain is started. The thinning disk cartilage may usually so narrow the intervertebral foramina for the nerve trunks that these are pinched or offset the articular facets, as pointed out by Williams (4). Pain will result from muscle spasm, which will still further irritate the nerve pathways or bring the facets more forcibly into contact, and pain will result, which will

cause more muscle spasm, and a vicious circle will be established.

The following case illustrates a similar but more advanced degree of bone change.

CASE V T M, a 62-year-old man, was lifting pieces of meat from a truck and hanging them on a rail in a packing house. He claimed that one foot slipped as he rotated his back in lifting a piece of beef from truck to rail and that simultaneously he felt a sharp pain in his back. He did not fall, and the slipping of the foot was nothing unusual. No proof of an accident could be established. The x-ray findings (Figs 6 and 7) were those of extensive hypertrophic spondylitis and arthritis.

The only unusual feature in this man's routine was that he began to feel pain while carrying on his usual duties. He finished his work for the day and then laid off because of persistence of the back pain. When he was examined by the Board, several months later, they were so impressed by the changes in the spine that they gave the somewhat equivocal opinion that "if this man had an accident" (which suddenly strained his back), he probably suffered an aggravation of the pre-existing osteo-arthritis to the extent of a 10 per cent general disability.

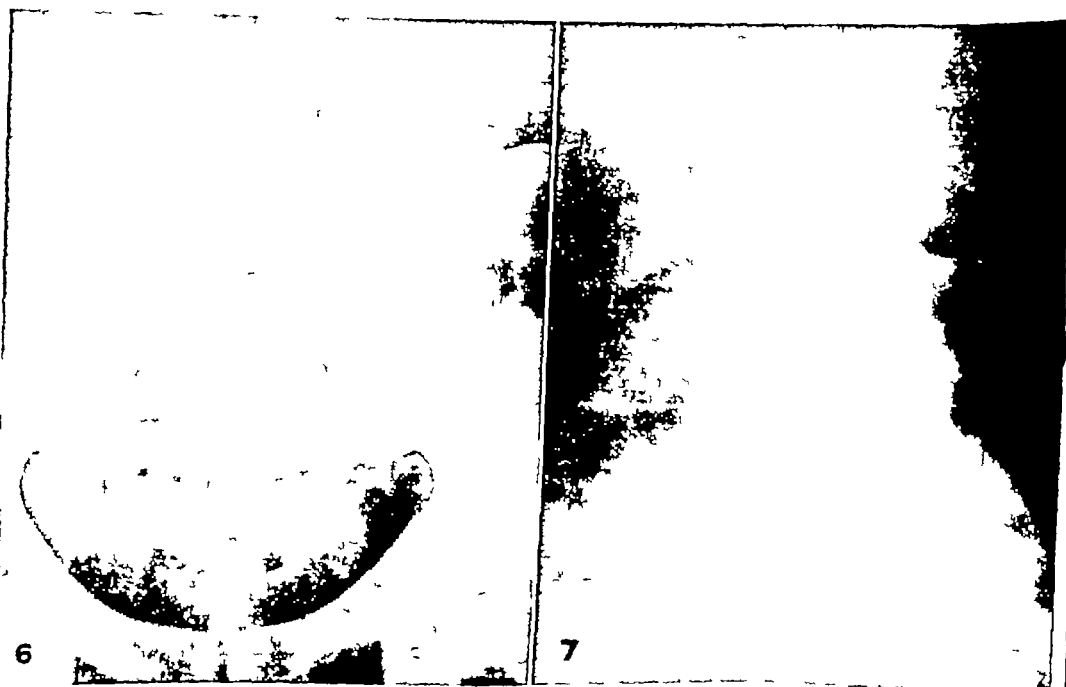
This and similar cases bring up an important question which this paper intends to discuss, and which the Advisory Board did not always try to answer. *When a man has a slowly developing arthritis of the spine which is being compensated for by adaptive changes in structure and mechanics, so that his working ability is not materially reduced, and some last-straw factor which would not cripple a normal back breaks this compensatory adaptation and results in disability, to what extent shall the disability be chargeable to the accident?*

CASE VI W J, a 62-year-old miner, while stooping, was struck in the lumbar area, on March 8, 1942, by a fall of dirt and rock. He claimed that he had been knocked down and had to be carried from the mine. A roentgenogram (Fig 8) showed extensive osteo-arthritis and possibly a complicating infectious arthritis. On Aug 31, 1942, he still claimed total loss of functional use of the back to a degree that the usual orthopedic examinations could not be carried out.

This workman claimed never to have suffered disability in the back prior to the



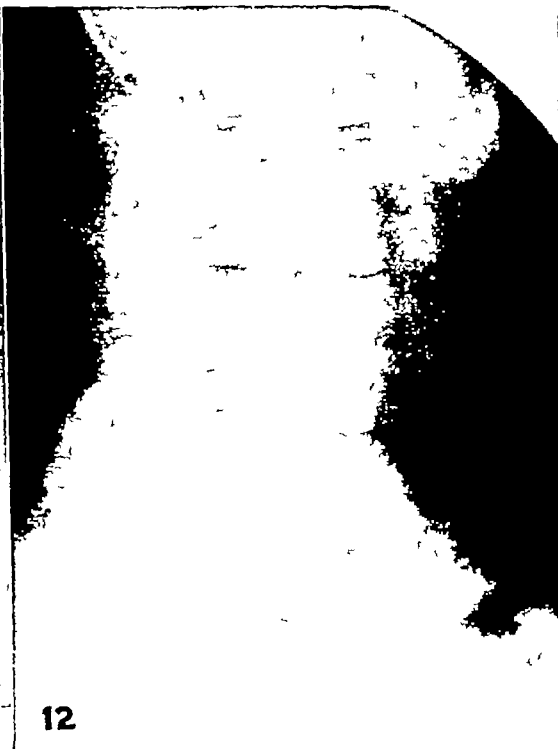
Figs 4 and 5 Case IV Chronic osteo-arthritis with osteosclerosis in the lumbosacral area. The lateral view (Fig 5) shows thinning of the disk, which was accompanied by vertical offset in the apophyseal facets shown best in an oblique view.



Figs 6 and 7 Case V Extensive lumbosacral osteo-arthritis. The lateral view (Fig 7) shows thinning of the disk and hypertrophic spurs on the lumbar vertebrae.



Figs 9 and 10 Case VII Beginning spondylolisthesis with slight bone reaction The oblique view (Fig 10) shows a defect at the pars interarticularis The defect was bilateral



Figs 11 and 12 Case VIII Spondylolisthesis with extensive osteosclerotic changes Fig 12 shows the offset of the fifth lumbar vertebrae, with disk degeneration and thinning The non fusion of the pars interarticularis was bilateral



Fig 8 Case VI Film made on day of injury, showing extensive osteoarthritis in entire lumbar area, claimed to be symptomless up to time of accident

accident and to be completely disabled afterwards. His disability was not questioned, but the Board's final decision was that he had enough arthritis to disable him and that only a small percentage of his continuing disability could rightly be charged to aggravation from injury. The final rating was a 10 per cent permanent general disability as the result of the accident.

Of the 25 patients with developmental anomalies, 10 were found to have a defective fifth lumbar arch, with actual or potential spondylolisthesis. This anomaly is an excellent example of a condition in which a variation from normal makes demands on the bony mechanism and other supporting structures which must be met by adaptive adjustments and protective reactions in bones and joints. The defective arch is present from birth, but only when the bones are fully developed and begin to meet the demands of an adult functioning back do the protective changes begin to show. Very seldom is the body

of the fifth lumbar shifted forward by a single trauma. In all the cases of this group, and in many others observed, where a forward shift of the vertebral body was found, hypertrophic changes indicating an old condition were present, pointing to a gradual development. Over a considerable period of time, the compensatory (adaptive) changes may be sufficient to protect the back and prevent the development of crippling symptoms, although many of these patients will give a history of vague discomfort or repeated disability from trivial causes. Eventually some accident or strain which would not cripple a normal back becomes the last-straw factor, the vertebral body tries to slip further forward, strain is thrown on ligaments and joint structures, and disabling pain is felt. X-ray examination leads to the discovery of the anomalous condition. These are difficult cases to evaluate. Four of the ten patients with defective fifth lumbar arches had fusion operations. In three of these the final rating was a 10 per cent general disability, which is considered a very good result, the fourth case was finally rated at 25 per cent general disability.

One patient with spondylolisthesis was given a 25 per cent general disability rating and, after a second accident, was found to have an additional 10 per cent disability, making a final rating of 35 per cent. In one case the rating was 35 per cent general disability as regards a functioning back, but the Board qualified this with the opinion that 20 per cent of this disability existed prior to the accident and only 15 per cent could rightly be ascribed to the injury in question. Two cases of spondylolisthesis call for special report—one in which 65 per cent general disability was allowed and one in which no disability was attributed to the alleged accident.

CASE VII F B was injured on Oct. 3, 1938, by turning his foot on a rock and straining his back. He claimed disability chiefly in the form of lower back weakness and inability to bend forward and lift a weight. On physical examination all back motions were found to be normal. X-ray examina-

Diffuse Calcification of the Pancreas¹

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THE LITERATURE contains only seventeen cases of pancreatic calcification other than stones. The infrequent mention of this condition in radiologic journals would indicate the desirability of individual case reports. In our first case the condition was proved by surgery. The second case is included because of the typical roentgen findings.

pital showed a duodenal ulcer. A later roentgen study elsewhere was negative. During the two weeks preceding admission, cramping epigastric pain had been present. Some pain was referred to the left shoulder.

Roentgen study, Aug. 15, 1944, showed an irritable duodenal bulb, a small bowel deficiency pattern, and a 60 per cent four-hour gastric retention. The findings were interpreted as being due to duodenal ulcer. The pain improved on an ulcer regime and the pa-



Figs. 1 and 2. Case 1. Calcification in the pancreatic bed. Fig. 2 (right) shows the calcification as it appeared in a gallbladder film.

CASE 1. A white male, 23 years of age, a sprayer in a lemon orchard, had been in good health until three years earlier. At that time he was in bed for seven days, complaining of epigastric pain, diarrhea, and some fever. After recovery from this acute onset, there was a recurrence of the epigastric pain every four to six weeks, with nausea and vomiting, usually lasting for five to seven days. In the past year the attacks had been more frequent. In 1942 a roentgen examination at a veterans hos-

pital was well for some months. He was readmitted to the hospital Dec. 8, 1944, complaining of sharp pain in the left abdomen.

Physical examination showed spasm over the entire left abdomen, more marked in the left upper quadrant. Laboratory findings were negative except that the urine contained acetone 4+ and diacetic acid 2+.

Roentgenograms of the abdomen showed absence of free air. The prone film (Fig. 1) revealed an

¹ Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill. Nov. 9-10, 1945.



13

Fig 13 Case IX. Disk extrusion at the fourth lumbar space left side

tion showed a bilateral defect in the fifth lumbar arch and beginning spondylolisthesis (Figs 9 and 10). The Board's final conclusion was that no disability existed which could not be explained on the basis of the anomaly alone.

CASE VIII H J M on Jan 12, 1938, fell head first into a tank at a brewery. The clinical symptoms suggested disk extrusion. The x-ray films showed a defective fifth lumbar arch and beginning spondylolisthesis (Figs 11 and 12). The lumbosacral changes were somewhat greater than in Case VII and the clinical evidences of disability more pronounced.

The Board rated the disability at 65 per cent. They recommended appropriate surgery, either for disk extrusion if visualization of the canal demonstrated this, or, if not, fixation surgery to the lower spine. The patient refused oleomyelography, and surgery was not done. Spontaneous improvement took place, so that a later Board rated the disability at 20 per cent general.

Only one oleomyelographic examination was made on this group of patients. Suspected or known disk extrusion or nucleus herniation cases were usually diagnosed and treated by individual surgeons without need for consultation with the Board,

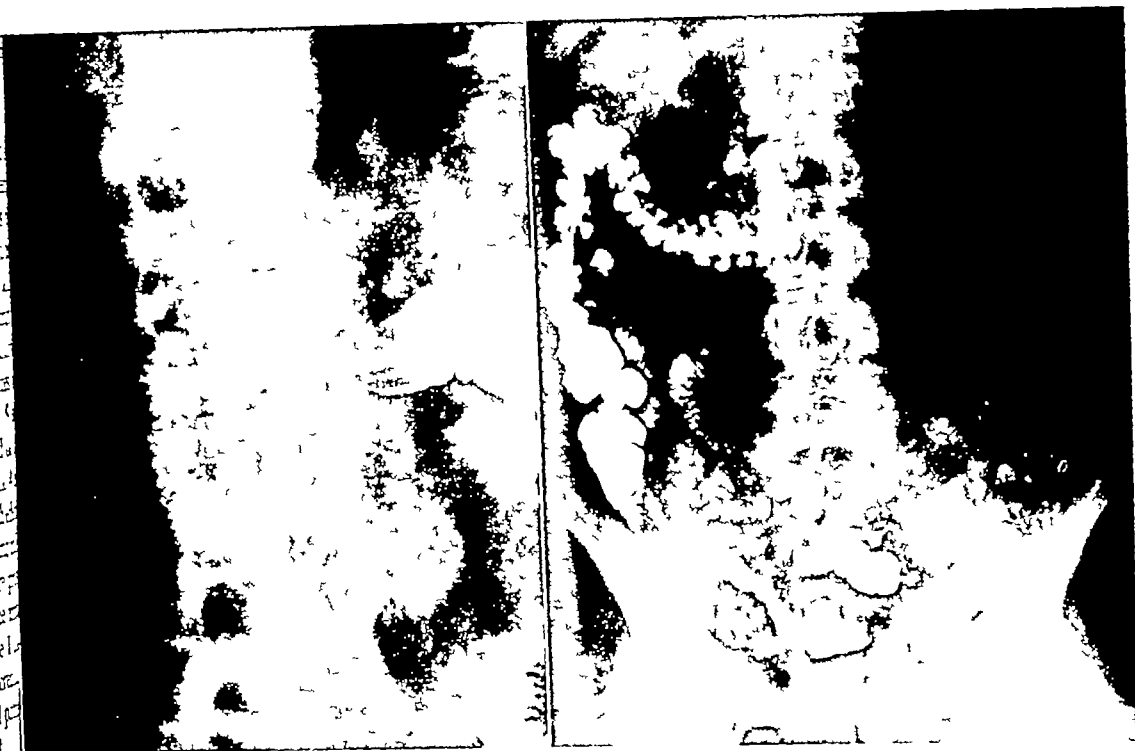
also, in the period covered by this report, the opaque oils available were not popular for the group of patients in question. Since the advent of pantopaque, myelographic studies are being made with much greater frequency. The one case examined by the Board (Case IX) is shown in Figure 13, with a defect in the oil column at the fourth lumbar disk.

After compensation or adaptation in the lower back has been broken by a last-straw strain, restoration of compensation is a long and tedious process. If one thing more than another has been impressive in the cases of low back disability studied by this Board, it is the absolute necessity for an intelligently directed and carefully supervised re-establishment of adaptive compensation or the rehabilitation of the worker. The regime aiming at recovery from a low back disability should be as closely supervised and meticulously directed as the "come back" of a patient with a healing cardiac occlusion, or a patient with healing tuberculosis of the lungs. Rehabilitation of the lower back, so that adaptation and compensation are restored, requires time, patience, close supervision, and the intelligent graduation of selected exercises. No careless instruction to "go out and do light work" or "take setting-up exercises" will meet the requirements. The come-back road in low back disability, like the "strait" road of Scripture, is difficult, but success lies at the end. The broad and easy way leads only to failure and disappointment.

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Figs 4 and 5 Case 2 Gastro intestinal studies Fig 5 (right) is the four hour film

of two questionable cases. By adding 4 of their own, they considered the total assured cases to number 15. They pointed out that these 15 cases of actual calcification of the gland were but 7.1 per cent of the 209 cases recorded with a diagnosis of pancreatic lithiasis. Darling (6) has recently published a single case, the only additional report in the available literature. Thus it would seem that, with the cases reported herein, there are some 19 recorded examples of diffuse pancreatic calcification in the literature to date.

Beling, Baker and Marquis (4) felt that calcification followed repeated attacks of pancreatitis. They found the average age to be around forty years, although the condition has been noted at all ages. It is predominantly a disease of males. Pasternack (7) stated that parenchymal calcification is a sequel of infection, inflammation and necrosis, citing the report of Edmondson and Fields (8) as evidence. Although the rate of production of radiographically visible calcification is not known, King and Waghelestein believed that it



Fig 6 Case 2 Abdominal film made five years before those in Figs 4 and 5

could be relatively rapid. In one case of their series of four, a marked increase in calcification was noted on films taken at an



Fig. 3 Case 1 Intravenous pyelogram, showing normal renal structures

"increase in density of the abdomen with etching of the loops of the gas-filled colon as evidence of fluid. Throughout the bed of the pancreas there are multiple calcium shadows, indicating calcification within that organ. These shadows were present in the barium studies of Aug. 15, 1944, and while obscured by the barium meal, they were well shown in the five hour film."

Intravenous pyelography showed normal renal structures, gallbladder function was shown by oral cholecystography to be normal and there were no biliary concretions (Figs 2 and 3).

Surgical removal of the distal two thirds of the pancreas, leaving the head, was accomplished and no diabetic signs have been noted. The decalcified specimen revealed only a few patches of normal pancreatic tissue. There was almost complete replacement by dense hyaline connective tissue containing numerous cysts and minute abscesses.

CASE 2 A 55 year old white male complained of vague epigastric pain which had been present for years, but not severe enough for hospitalization. A chronic productive cough was explained by roentgen studies with opaque oil as being due to bronchiectasis.

Gastrointestinal roentgen studies showed no lesions in the stomach, duodenum, or colon. Opacities of calcium density, measuring 1 to 6 mm., were present in the pancreatic area. None of these showed lamination and their shape was irregular. Their distribution was more marked within the loop of the duodenum (Figs 4 and 5).

Five years earlier the patient had been hospitalized for chronic alcoholism. Because of vague pain in the lower right abdomen, a roentgenogram was made of the urinary tract. Opacities in the upper abdomen were regarded as opaque material in the stomach (Fig. 6). The patient did not complain of epigastric pain at the time. Laboratory

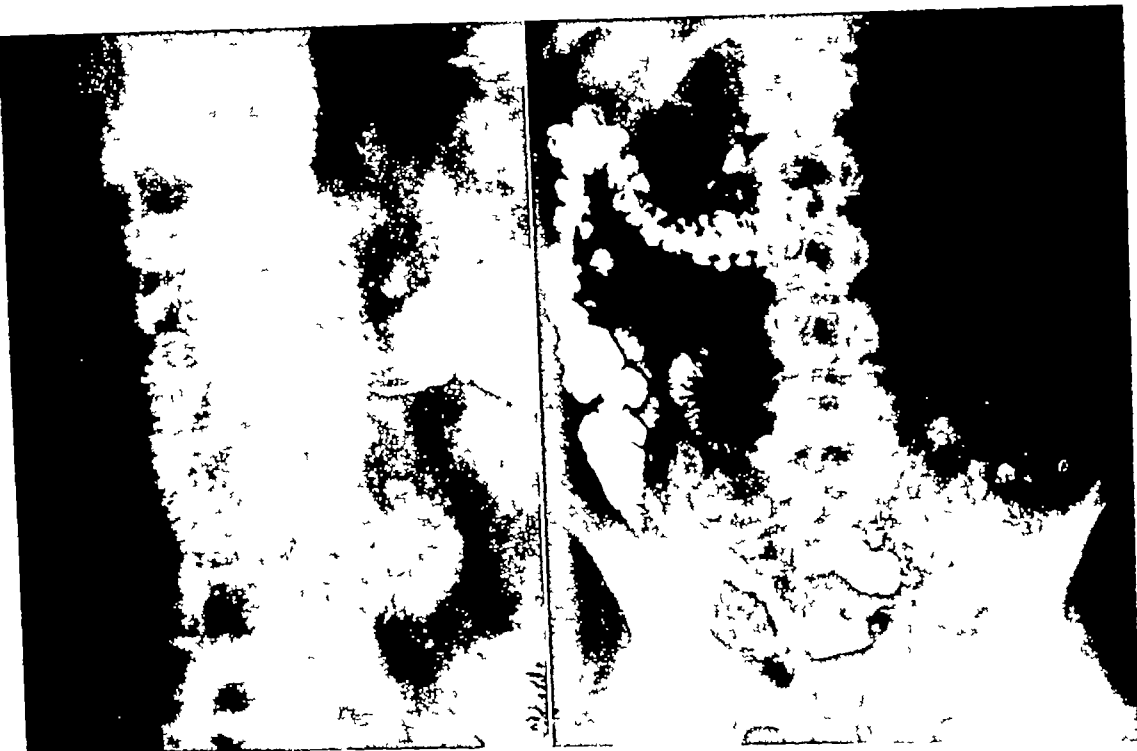
findings were negative. There was no indication of diabetes.

DISCUSSION

The symptoms of pancreatic lithiasis and pancreatic calculi would seem to be quite similar. As in the cases reported here, the pain is recurrent, severe, and may be referred to the back. Snell and Comfort (1) summarized the findings in 18 cases of pancreatic lithiasis as follows: 11 had colic, 8 motor disturbances of the stomach and small intestine, 8 showed signs of diabetes, either actual or latent, 6 showed weight loss, 8 diarrhea, 4 hepatic enlargement, 1 had ascites with edema and jaundice, and 2 had complicating infection. Several of these findings were present in the cases reported here. The irritability of the duodenal bulb in Case 1 may well have been the result of pancreatic irritation, and the small intestinal pattern suggests the same causative agent.

As a result of their observations, Snell and Comfort felt that roentgenograms of the pancreatic area should be made in patients who "present (1) obscure attacks of abdominal pain or gastro-intestinal storms of uncertain origin, (2) diarrhea with fatty stools, (3) unexplained enlargement of the liver with or without ascites, (4) diabetes, particularly when associated with such abdominal symptoms as colic or diarrhea, (5) jaundice of indeterminate nature."

Although much has been written on the subject of pancreatic calculi, there is relatively little to be found in the literature on diffuse calcification of the pancreas. Jaleski (2) found 220 cases of calculi reported prior to 1942, while Beling (3), in 1940, could collect but 12 instances of disseminated calcification. To this he added a thirteenth. In a subsequent summary, Beling, Baker and Marquis (4) again mentioned the rarity of the condition as they reported another case. King and Waghelstein (5) commented on the infrequency of pancreatic calcification as a pathologic entity and on the even more unusual clinical diagnosis. Reviewing the report of Beling, they disagreed with his inclusion



Figs 4 and 5 Case 2 Gastro intestinal studies Fig 5 (right) is the four-hour film

of two questionable cases. By adding 4 of their own, they considered the total assured cases to number 15. They pointed out that these 15 cases of actual calcification of the gland were but 7.1 per cent of the 209 cases recorded with a diagnosis of pancreatic lithiasis. Darling (6) has recently published a single case, the only additional report in the available literature. Thus it would seem that, with the cases reported herein, there are some 19 recorded examples of diffuse pancreatic calcification in the literature to date.

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Fig 6 Case 2 Abdominal film made five years before those in Figs 4 and 5

could be relatively rapid. In one case of their series of four, a marked increase in calcification was noted on films taken at an

interval of eighteen months. Interestingly, there had been no symptoms of an inflammatory process during that time.

All writers stress the roentgen demonstration as the only approach to a clinical diagnosis. Beling, Baker, and Marquis urged the routine examination of the abdomen in the presence of any type of abdominal complaint, particularly if there is recurrent pain. They felt that a preliminary flat plate is most important, since dye or barium may obscure the fine calcium shadows. Localization of the shadows may be clarified by the use of gas, air, or barium in the stomach, with films in lateral and oblique positions as well as in the anteroposterior and postero-anterior projections.

The differential roentgen diagnosis should not be difficult. Diffuse pancreatic calcification characteristically outlines the gland in its usual position. A fine trabeculation throughout the bed of the pancreas, extending from the loop of the duodenum to the tip of the spleen, should not be confused with other upper abdominal calcification. Pancreatic calculi are larger and are usually confined to the head of the gland. Biliary and urinary calculi, calcified nodes, calcification in the costal cartilages and in the liver and spleen, are distinguishable either directly or by supplementary studies with selected dyes. Adrenal calcification may conceivably be confused, but this tends to be quite discrete and should be recognized by its relationship to the renal shadow. If doubt still remains, the use of the methods advocated

by Beling, Baker, and Marquis will certainly be conclusive. The rarity of the condition makes its clear demonstration most desirable and warrants a careful radiographic examination.

SUMMARY

Two cases, one proved at operation and one having the roentgen criteria of disseminated pancreatic calcification, are reported. The rarity of the condition is obvious from the paucity of reports in the literature. It is quite probable, however, that its occurrence is more frequent than the published reports would indicate and the diagnosis should certainly be sought in all cases of obscure recurrent abdominal pain.

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Obstructive Hydronephrosis

Produced by Aberrant Blood Vessels and Diagnosed by Intravenous Urography¹

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ABERRANT blood vessels of the kidney are not uncommon, and very often they produce obstructive hydronephrosis. Until the year 1906, the presence of these blood vessels was of academic interest only, since they were usually found at autopsy or at the surgical table. In that year, the cystoscopic method of pyelography was

aberrant blood vessels has been facilitated by the introduction and subsequent improvement of intravenous pyelography, so that at present the preoperative diagnosis is a common occurrence.

Intravenous Pyelography versus Retrograde Pyelography The intravenous method of urography lends itself admirably

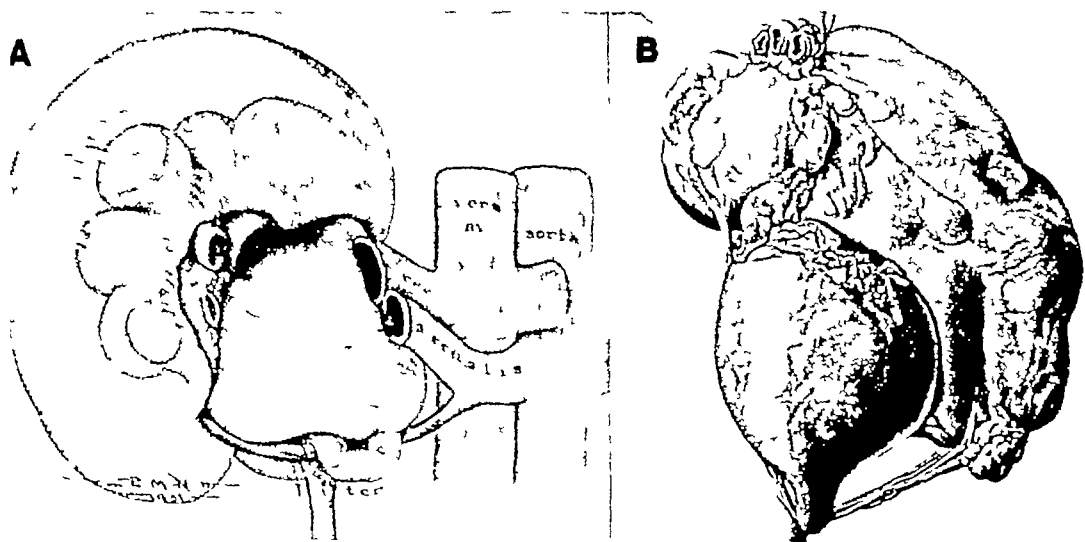


Fig 1 Diagrammatic illustrations of hydronephrotic kidney caused (A) by a large anomalous artery crossing the upper ureter and (B) by either an adhesive band or obliterated blood vessel

produced, that is, radiography of the renal pelvis and ureters after the injection of a radiopaque solution (such as sodium or potassium iodide), with the aid of the cystoscope and ureteral catheter. Shortly after that, Ekehorn suggested the possibility that aberrant blood vessels of the kidney might in some instances produce obstructive hydronephrosis. However, the preoperative diagnosis in such cases was made only rarely. Recently, the diagnosis of obstructive hydronephrosis due to

to the investigation and to the establishment of the diagnosis of obstructive hydronephrosis produced either by aberrant blood vessels or by any other cause. With this method, we usually obtain roentgenograms demonstrating the true shape, size, and position, as well as function, of the kidney, in contradistinction to the retrograde or cystoscopic method, in which the urinary tract may be either under- or over-distended, unless the pressure of the injected fluid is carefully regulated. The intravenous method causes practically no disturbance of the normal physiologic function of the kidney and does not produce

¹ Accepted for publication in February 1946

² Director, Department of Roentgenology Cedars of Lebanon Hospital Los Angeles Calif

spasm of the urinary tract nor temporary anuria, conditions often encountered with the instrumentation of cystoscopic examination

Prevalence of Aberrant Blood Vessels

The presence of aberrant blood vessels is so common that Anson, Richardson, and Minear, in a careful dissection of two hundred cadavers, found only 35 per cent with normal blood vessels supplying both kid-

at the lower pole of the kidney, situated anterior to the ureteropelvic junction, may produce obstruction (Fig 1). Normally, the kidney is supplied by one renal artery, a branch of the abdominal aorta. It usually enters the kidney through the hilum, where it breaks up into smaller blood vessels, to form the complex renal blood supply. Occasionally, the renal artery branches out, fan-like, before it enters the hilum, and one

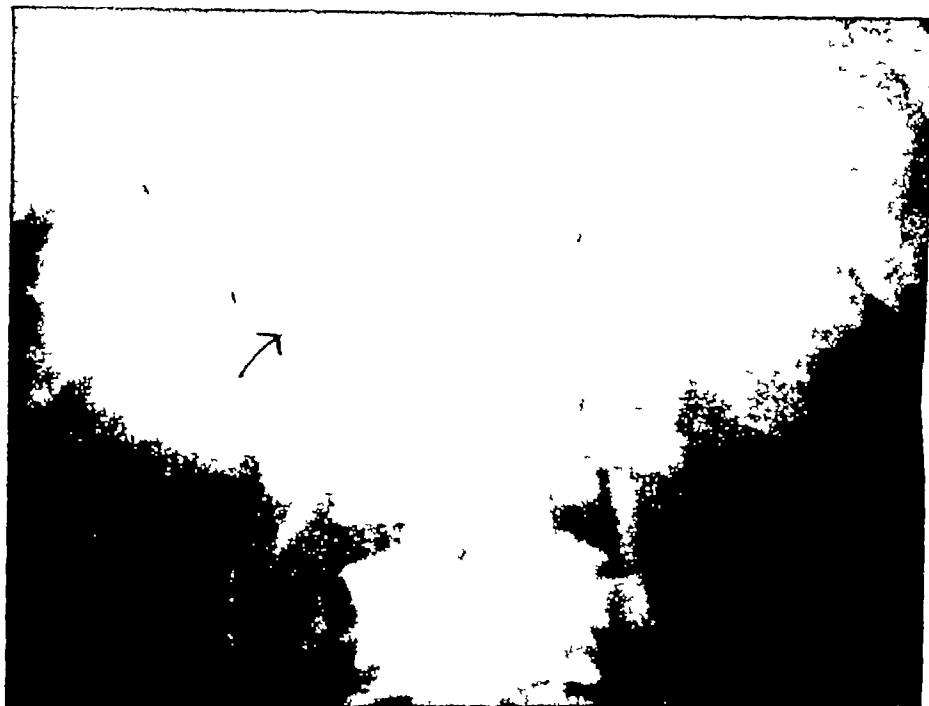


Fig 2 Break in continuity of the ureter at the ureteropelvic junction produced by an aberrant blood vessel causing obstructive hydronephrosis

neys, the remainder had anomalous vessels of either one or both organs. The same authors quoted Jeldell (1911)

"So complex is the vascular network in the mesonephric area of the embryo, that one is surprised not in encountering examples of supernumerary vessels in the adult, but rather in finding any case in which a single artery supplies each kidney."

Fortunately, not all aberrant blood vessels produce obstruction, more than half are found at the upper pole of the kidney, above the hilum, and these obviously could not produce ureteral obstruction. Only those blood vessels which are found

or more of the lower branches of this vessel attaches itself to the lower pole of the kidney, forming an aberrant blood vessel. Often, an independent branch of a lower segment of the abdominal aorta is found supplying the lower pole of the kidney. Occasionally, instead of a blood vessel, we find at operation a narrow band crossing the ureter, which microscopic analysis proves to be an obliterated blood vessel.

The question always presents itself: Why do symptoms of hydronephrosis occur during adult life, and only rarely in childhood, in spite of the fact that the aberrant

blood vessel is a congenital anomaly? The answer, I believe, lies in the fact that the urinary tract and the blood vessels belong to two quite distinct sets of organs, each undergoing different characteristic changes during life. The blood vessel may lose some of its elasticity, while the kidney may move down to a lower position, thereby falling over, so to say, a stretched blood vessel, consequently compressing the ureter.

Importance of a Complete Diagnosis In the present state of development of diagnostic roentgenology, it is not enough for the roentgenologist to consider the finding of hydronephrosis a complete diagnosis, he must endeavor to establish the cause, whether obstruction or infection, and if obstruction, what kind and where, so that the proper treatment may be instituted.

Roentgen Findings The urographic findings in hydronephrosis, for the purposes of this presentation, may be divided into two groups: (1) general findings common to hydronephrosis, regardless of cause, (2) specific findings characteristic of hydronephrosis produced by aberrant blood vessels.

(1) The first group of findings as seen on the x-ray film are as follows:

(a) Blunting, enlargement or spherical dilatation of the minor calices, abbreviation or dilatation of the major calices, dilatation of the renal pelvis. The degree of involvement of these structures depends on the severity and duration of the case.

(b) Increased radiopacity of the shadow of the hydronephrotic pelvis produced by the excreted chemical³ on the affected side, as compared with the radiopacity of the pelvis of the opposite, unaffected side. This increased radiopacity is due to the larger volume of the affected pelvis.

(c) The normal renal pelvis, as demonstrated on the roentgenogram, is usually empty when the patient is in the upright posture. With ureteral obstruction, the pelvis is either partly or completely filled, even with the patient upright, producing a urinary stasis above the obstruction. This



Fig 3 Square renal pelvis, with the ureter inserted in the angle of the square. Note also the constriction at the ureteropelvic junction which, at operation proved to be due to an aberrant blood vessel.

urinary stasis increases the dilatation of the renal pelvis, forms precipitates of urinary salts which aid in the formation of renal calculi, and is responsible for the subjective symptoms. It also predisposes the kidney to infection.

(d) The ureter is usually empty below the point of obstruction.

(2) The second group of roentgenographic findings are those due to aberrant blood vessels.

(a) It is obvious that the aberrant blood vessel producing the obstruction is not visible on the film, as it is practically of the same density as the surrounding tissue, so far as x-rays are concerned. One sees, however, on the intravenous urogram, when the pelvis and ureter are filled with the excreted radiopaque solution, a break in continuity, or a sharp narrow line at the ureteropelvic junction crossing the ureter (Fig 2). This sharp line is the constric-

³ Disodium N-methyl-3,5-diiodochelidamate (Neopax)

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Fig 4 "Derby-hat appearance" of the pelvis. A double constriction is present at the uretero-pelvic junction by two blood vessels.

tion produced by the aberrant blood vessel. Occasionally, more than one such line is present, probably due to several branches of the blood vessel crossing the ureter. Often, the constriction is hidden behind the renal pelvis, in which event the distal end of the pelvis may form a small knob-like dilatation.

(b) As the obstruction develops, either insidiously or rapidly, a characteristic change is found in the outline of the renal pelvis. Normally, the pelvis is funnel-shaped, tapering down gradually to meet the ureter. When an aberrant blood vessel crosses it, the pelvis forms a right angle or a square, the mesial border of the pelvis is parallel and adjacent to the edge of the psoas muscle, the ureter is seen at the lower mesial corner of the square. The proximal end of the ureter, in this case, does not flare out to meet the pelvis, but is of uniform caliber throughout, like a drinking straw (Fig 3).

(c) As the hydronephrosis progresses, the pelvis loses its angular or square shape and

assumes a "derby-hat appearance," with the ureter in the center of the crown. The pelvis retains this shape, even when it reaches its maximum dilatation (Fig 4).

(d) The minor calices become affected a much later period, when the pelvis is already perceptibly involved. This is true in all high ureteral obstructions.

(e) On several occasions at operation, instead of aberrant blood vessels, adhesions or adhesive bands were found crossing the ureteropelvic junction. Microscopic study of these adhesions showed obliterated blood vessels among them.

CONCLUSION

The value of demonstrating the change in appearance of the renal pelvis to square or derby-hat shape lies in the fact that from this alone a correct diagnosis can be made, even when the obstructive line in the ureter produced by the aberrant blood vessel is hidden behind the pelvis and is not visualized on the film.

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A Practical Technic for Visualization of the Bronchial Tree¹

GILBERT W HEUBLEIN, M D, and CLARENCE D N GILFILLAN, M D

BRONCHOGRAPHY as a diagnostic measure is often indicated when any of the following conditions is suspected: bronchial obstruction, mural growth, pulmonary neoplasm, atelectasis, recurrent bronchopneumonia, a chronic suppurative process. The procedure is definitely contraindicated in the presence of acute inflammatory disease of the tracheobronchial tree. It should be deferred in patients with acute upper respiratory infection and should be used with hesitation in those suffering from asthma.

Bell (1), in a recent communication dealing briefly with the method of bronchography in use at the Percy Jones General Hospital, emphasizes the importance of complete mapping of the bronchial tree by use of lipiodol. He writes:

"Bronchography with lipiodol as a contrast medium is an important examination and no effort is spared to delineate all portions of the bronchial tree. The importance of complete filling of all branches is shown by the number of patients in whom there has been bronchiectasis in one of the lower lobes, but with involvement of other lobes as well. This is particularly true of the lingular branch of the bronchus of the left upper lobe. If bronchography is resorted to, a complete examination of all branches is essential.

"All lipiodol instillations are done in the X Ray Department by a member of the chest group. The injection is made through a flexible catheter passed into the upper part of the trachea. The filling of the bronchial tree is done under fluoroscopic guidance, making certain that all branches are satisfactorily outlined, the patient being placed in various positions to insure complete filling of all lobes."

The purpose of this paper is to present in greater detail the technic referred to by Bell, describing more specifically the positioning of the patient and the manner of instilling the contrast medium. The procedure finally established was evolved through the co-operative effort of various individuals, particularly the physicians of

our chest group, and through valuable experience gained by trial and error. This method, although not entirely unique, has the advantage of speed and accuracy.

PREPARATION

The patient is given postural drainage for a period of fifteen minutes the night and morning before the examination. The postural drainage should be completed one hour prior to bronchography.

For the average adult patient, unless there is some contraindication, medication consists of sodium nembutal or seconal, gr 1 1/2, given two hours before, and morphine sulfate, gr 1/4, administered one hour before the expected time of arrival in the X-Ray Department. Atropine is contraindicated, since it produces inspissation of the bronchial secretions and prevents adequate filling of the terminal bronchioles.

In general, asthmatic patients do not withstand bronchography well, and this procedure is ordinarily reserved until all other diagnostic methods have failed to demonstrate co-existing tracheobronchial pathological changes. The medication of choice in such cases is adrenalin 1:1000 to 1:10,000, as morphine sulfate is usually not well tolerated.

The patient is taken to the fluoroscopic room on a litter. Upon arrival in the X-Ray Department his fears are allayed by describing the procedure to follow. Assurance is given that no undue difficulty will be encountered during the subsequent examination. This is done to obtain maximum co-operation. The patient is further instructed to follow directions and is specifically warned that he must refrain from coughing.

After the patient's confidence has been gained, the oropharynx and tonsillar fossae are anesthetized with swabs of pontocaine.

¹ Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

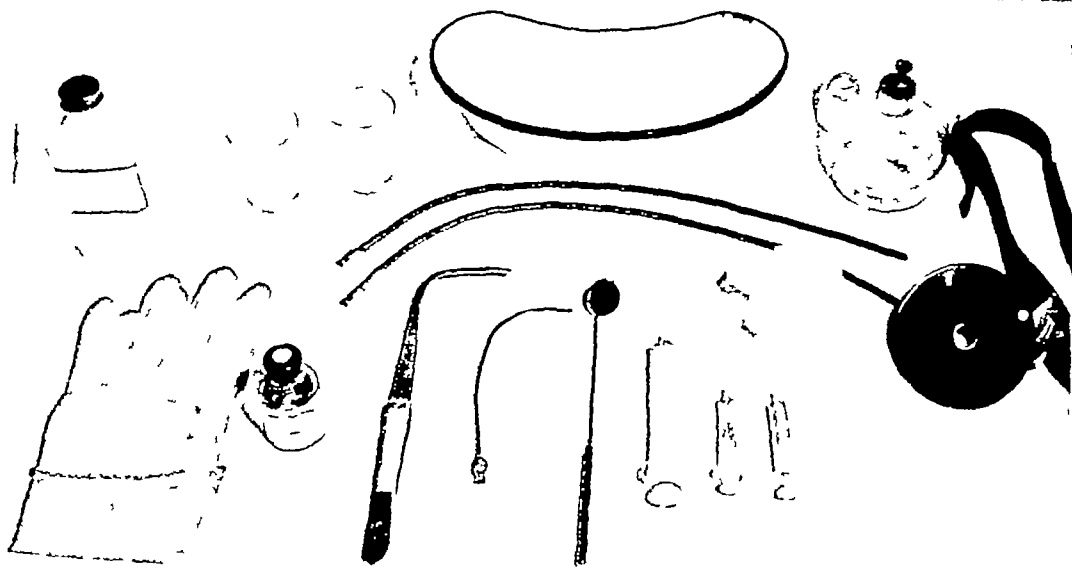


Fig 1 Instrument set-up for bronchography This should include 2 per cent pontocaine Jackson laryngeal forceps, laryngeal cannula, flexible catheters with metal adapters and 2- 3- and 10-c c syringes Lipiodol (La Fay) 40 per cent is the contrast medium used

2 per cent (Fig 1) ² In like manner, by means of the Jackson laryngeal forceps and swabs, the piriform sinuses are anesthetized, as is the dorsal surface of the tongue and epiglottis Then, aided by indirect laryngoscopy, the examiner drops 0.5 c c of 2 per cent pontocaine directly on the vocal cords, through a laryngeal cannula Following this, 2 c c of the pontocaine mixture is injected directly into the trachea (Fig 2) and the patient is instructed to cough in order to spray the anesthetic agent throughout the tracheobronchial tree

A No. 14 flexible rubber catheter is passed through the nose and the nasopharynx, into the proximal third of the trachea (Fig 3) The external portion of the catheter is strapped to the face by adhesive tape, and the patient, sitting on a stretcher, is positioned in front of the upright tilt table or fluoroscope

A syringe containing 10 c c of lipiodol is securely locked to a metal adapter at the proximal end of the catheter The position of the catheter is checked by fluoroscopy

² The authors are indebted to Mr. H. Wall for his excellent photographic reproductions

and care is taken to see that the tip lies above the carina, so that either the right or left stem bronchus may be injected

EXAMINATION

The patient should be sitting with his hips slightly anteriorly, thus forming a 25 to 35-degree angle between his back and the table top, to facilitate filling of the dorsal bronchi (Fig 3) The involved side is examined first The patient is positioned in a 10-degree lateral tilt until a small amount of lipiodol, approximately 2 c c, reaches the stem bronchus in question As the lipiodol passes the carina into the stem bronchus, the patient is restored to the vertical position Because of its viscosity, the oil will continue to flow into the paracardial and mediastinal branches, usually without entering the opposite side As soon as it is ascertained that lipiodol is entering the lower lobe secondary bronchi, the patient is tilted into the extreme lateral position, with the upper shoulder rotated anteriorly, as demonstrated in Figure 4

If the right lung is the first to be examined, as the lipiodol enters the orifice of the middle lobe bronchus, the patient is



Fig 2 Position of examiner prior to injection of pontocaine (2 c c of a 2 per cent solution) into the lumen of the cervical trachea. Topical anesthesia has previously been applied and has taken effect. The laryngeal mirror, held in the examiner's left hand, affords a satisfactory view of the vestibule and vocal cords.

Fig 3 Position of the radiologist with respect to the physician and patient during instillation of lipiodol. Note the angle (a) between the patient's back and the table top. This posture facilitates complete filling of the dorsal bronchial radicles.



Fig 4 To fill the right middle bronchus the left shoulder is rotated forward as shown. The lingular branch of the bronchus of the left upper lobe is outlined by the reverse of this procedure, & e positioning the patient to the left with ventral rotation of the right shoulder

Fig 5 The apical branches are filled by placing the patient in the modified knee-chest position. The shoulder on the opposite side is slightly elevated

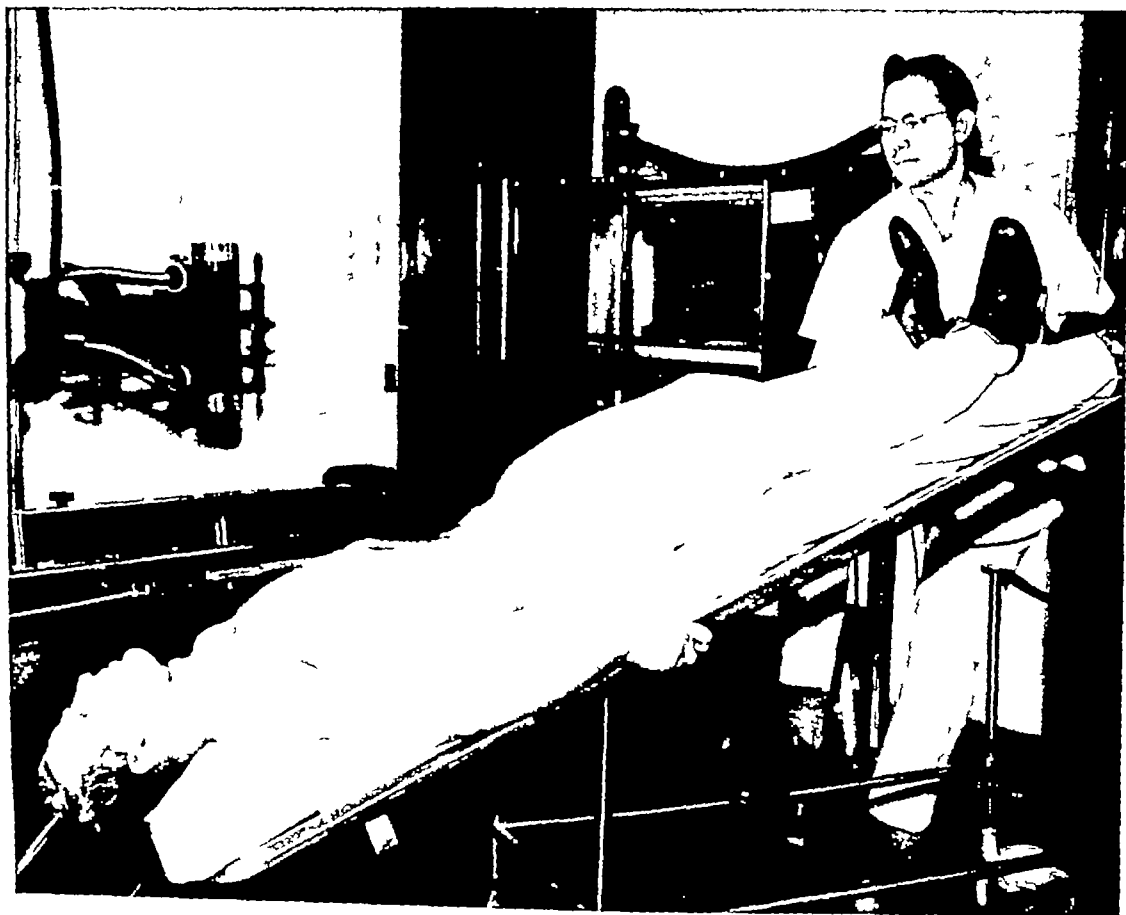


Fig 6 Posture of patient in dorsal recumbency, with the foot of the stretcher elevated. Preceding radiography the patient is rolled to the lateral decubitus on the side under investigation and finally turned to the prone position, with the foot of the stretcher still elevated.

brought well down on the right shoulder, the left shoulder being rotated anteriorly. Lipiodol should be injected continuously during this procedure. If it is now demonstrated that lipiodol has entered the upper lobe bronchus, the patient is placed in a modified knee-chest position to ensure adequate filling of the apical branches (Fig 5). He is then requested to lie prone on the litter, the foot of which is elevated approximately 30 to 35 degrees. He is also instructed to turn on the affected side and finally assumes a position of dorsal recumbency, as in Figure 6.

As soon as the above procedure is completed, the skin is inspected to make certain that no lipiodol is present externally. Erect postero-anterior, left anterior oblique, and right lateral films are then obtained.

As soon as these exposures have been

made, a similar procedure is carried out for the left lung field. The left stem bronchus and paramediastinal branches are injected and the left side is completely filled, with anterior rotation of the right shoulder, and with the patient in the extreme left lateral decubitus position as in Figure 7. As before, the foot of the litter is elevated so that the upper lobe branches are fully outlined. As soon as this positioning is completed, the patient is again placed in front of the plate changer and erect postero-anterior and right anterior oblique views of the left lung field are made (Fig 8).

Failure to fill a specific branch of the lower lobe is not an indication for continued injection of lipiodol, as pooling may result in some areas, completely obscuring the entire lung field. The whole procedure ordinarily requires seven to ten minutes.



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If cyanosis develops during the examination, only one side is injected and bronchography of the opposite lung field is reserved for a later date. This is not infrequently the case in patients with a history of asthma, even without previous history of iodine sensitivity.

The catheter is finally removed and the patient instructed to expectorate as much mucus as possible. Postural drainage under

signs and symptoms, as described by our anesthesia service at the time, were as follows: fall in blood pressure, bradycardia, providing no epinephrine had been previously used, pallor, sweating, apprehension, tremor, dyspnea, mild cyanosis, convulsive seizures similar to those noted in grand mal attacks, including tongue biting, cyanosis, frothy mucus at the mouth, and convulsive movements of the body.

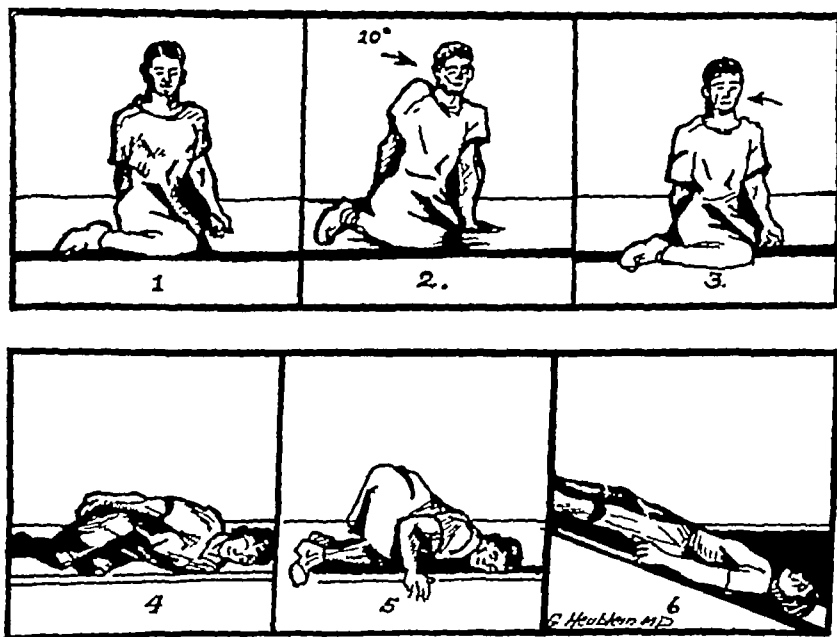


Fig 7. Composite illustration showing posturing of patient throughout investigation of the left lung field. 1 Position at beginning of examination. 2 Ten degrees tilt to the left. 3 Return to vertical. 4 Left lateral decubitus. 5 Modified knee-chest position. 6 Trendelenburg.

the supervision of the ward nurse is carried out as soon as the patient returns to his bed.

REACTIONS

Occasionally on completion of bronchography the patient runs a low-grade fever for one to three days. This is usually transient and of no serious consequence.

Untoward reactions are not altogether unusual with topical anesthetic agents but were not encountered when we changed from 5 per cent cocaine hydrochloride to 2 per cent pontocaine. The reactions in all cases were mild to moderate. The

The treatment outlined by Tuohy (3) is as follows:

- 1 Cessation of administration of anesthesia
- 2 Immediate intravenous administration of a soluble barbiturate, such as pentothal sodium 2.5 per cent, or solution of sodium amytal or nembutal. The barbiturate is administered slowly in fractional doses, which are usually enough to control the convulsions.
- 3 Inhalation of oxygen
- 4 Careful supervision of the patient after the convulsion has been arrested.



Fig 8 Bronchograms obtained by method described in text. These show complete visualization of all branches of the bronchial tree. Note the excellent delineation of the lingular branch on the right anterior oblique projection.

rested, since repeated attacks may occur if an insufficient amount of barbiturate has been administered.

The importance of having oxygen and pentothal sodium, 2.5 per cent, readily available cannot be too greatly stressed.

Tovell (2) states that pontocaine reactions, when they do occur, are readily remediable providing oxygen and a soluble barbiturate are available. Cocaine hydrochloride, on the other hand, is particularly dangerous because of its toxic action on the cardiac musculature.

Reactions may be avoided by conservative administration of the topical anesthetic. Indiscriminate spraying of the pharynx and glottic area and the use of sopping wet pledgets of cotton are contraindicated (Tuohy).

SUMMARY

A simplified method of lipiodol bronchography has been briefly outlined. The success of the procedure depends upon adequate preparation, proper choice and

application of the anesthetic agent, and careful, rapid positioning of the patient under fluoroscopic control to obtain complete mapping of the bronchial tree.

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Cephalopelvimetry¹

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ALTHOUGH childbirth is a normal physiological function, one is impressed with the many difficulties of the obstetrical patient, and also of the obstetrician, despite the fact that nature has apparently provided a considerable margin of safety. Statistically, in only a very small percentage of all pregnancies is a true cephalopelvic disproportion encountered. It is of interest, however, to the obstetrician, should his patient be in this classification.

Since 1897 (1) attempts have been made to measure the maternal pelvis roentgenologically. The various methods of pelvimetry—external, internal, and radiologic—give information relative to the linear measurements and conformation of the pelvis, but the fetus for the most part has been assumed to be normal. Any method of measurement that does not consider the fetus to be delivered with an accuracy comparable to that with which the linear measurements of the maternal pelvis are determined must be considered incomplete.

From a practical standpoint, it seems illogical to calculate the linear measurements to one-tenth of 1 per cent when, in the natural course of events, the physiological process allows for a 20 to 30 per cent margin of safety. This margin is further influenced by factors of morphology, dynamics, moldability, resistance, position, and presentation, some of which cannot be evaluated by roentgen methods. Obviously, somewhere between the meticulous measurement of radiology and the utter disregard of any roentgen study there must be a common meeting ground between the obstetrician and the radiologist.

The obstetrician who is entrusted with the responsibility of the mother and child should be the judge of the necessity for

cephalopelvimetry, but there are indications other than personal judgment, as when the clinical examination and the history suggest abnormality of size or type of pelvis, or size of fetus, when there is a history of previous dystocia or fetal death, when vaginal examination is contraindicated or such examination gives insufficient information, and, lastly, during labor, if dystocia is present, to localize the site of the arrest. For the most part, however, labor is an emergency which does not readily lend itself to diagnostic procedures, except those of maximum simplicity, and, as a general rule, accuracy and simplicity do not go hand in hand. With few exceptions, a patient in active labor is primarily an obstetrical and not a radiological problem. Hence, only by proper preliminary teamwork between the obstetrician and the radiologist can warning be given and possible disaster be circumvented.

As Hirsch (2) pointed out in 1922, all methods of roentgen pelvimetry represent modifications of the following: (1) comparative method, (2) teleroentgen or orthodiagraphic method, (3) position frame method, (4) stereoscopic method, (5) triangulation method. The last three are considered to be highly accurate and informative when properly evaluated, but no single one of these methods is without some inadequacy or limitation.

One of the factors contributing to the difficulty of labor is the size and weight of the fetus. Unquestionably, weight and size are to be considered, but if the head of an apparently normal fetus can be delivered, the act of parturition can be consummated. From a clinical-obstetrical as well as a roentgen mensuration standpoint, cephalopelvimetry resolves itself into two

¹ From the Departments of Radiology and the Departments of Obstetrics, Kansas City Municipal Hospital No. 1 and St. Luke's Hospital, Kansas City, Mo. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

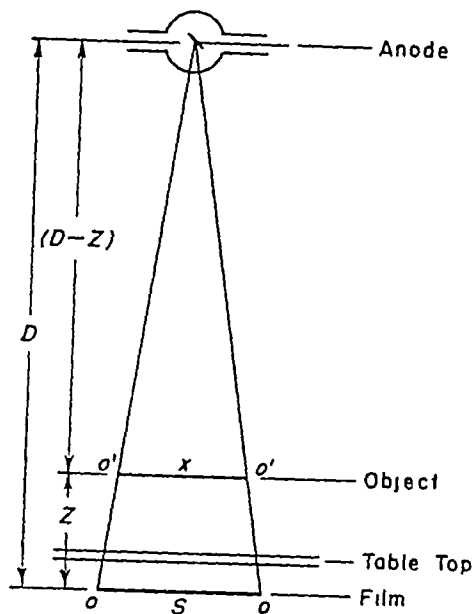


Fig 1 D represents the anode-film distance, $(D - Z)$ the anode-object distance, S the size of the shadow on the film λ the size of the object. By proportion and construction

$$D (D - Z) = S \lambda$$

Solving for λ

$$D \lambda = S (D - Z)$$

$$\lambda = \frac{S (D - Z)}{D}$$

main procedures determination of the capacity of the maternal pelvis and determination of the size of the head that must be delivered. Other factors, as presentation, position, and morphology, are partially determined by roentgen methods, but the unknown factors of dynamics, moldability, resistance, rotation, and descent can only be evaluated clinically. If, however, the obstetrician can be informed as to the capaciousness of the individual pelvis relative to the size of the fetal head, the remaining problems are matters of experience and judgment.

To fulfill the radiological requirements, the following criteria are submitted

1 The measurements must be accurate to within a small margin of error

2 The measurements should have a common denominator of comparison

3 Pertinent facts must be available and understandable and should be easily interpreted by both radiologist and obstetrician

4 The method should have few if any limitations of applicability and should be a benign procedure in so far as the patient and the fetus are concerned

5 The procedure should be capable of accurate duplication under ordinary working conditions

6 Personal factors should be obviated

It is not the purpose of this paper to review the voluminous literature on pelvimetry and fetometry, but to present a modification of a method which provides valuable information for obstetrician and radiologist, and meets the requirements and limitations imposed by pregnancy.

The method proposed by Ball and Marchbanks (3), in which the linear measurements of the maternal pelvis and the circumference of the fetal skull can be expressed in terms of volume, represents a decided advance in roentgen cephalopelvimetry and has caused a considerable awakening of interest. This method of measurement depends on several assumptions which admittedly are in slight error but are valid within practical and physiological limits. In most other methods of cephalometry, attempts are made to measure the linear diameter of the fetal skull, but there is no assurance that the particular linear diameter measured represents the dimension that is to be delivered. Also, because of rotation and position of the fetal head, this linear measurement is difficult to obtain accurately and is unquestionably subject to considerable error.

In the formation of roentgen shadows, as shown in Figure 1, when the anode-film distance is known and the anode-object distance can be ascertained, one can compute the size of the object from the size of the shadow on the film. Furthermore, by obtaining the linear dimension of the pelvis at various fixed points, the volume of a sphere that can be placed between these points can be calculated, as the volume of a sphere is $\frac{4}{3} \pi r^3$.

The volumetric determination of the fetal head offers a slightly more feasible problem. While it is true that the fetal head is in most instances spheroid, it is also

approximately true that, if the circumferences of the spheroid are taken at right angles, the volume determined from their mean average will approach the volume of a sphere having the same perimeter measurement. Practically, therefore, the fetal head may be considered a sphere. During the course of labor the various circumferences (and, in turn, the diameters) of the head are influenced by the driving force of the uterus, the resistance of the soft tissue, and the bony structures of the maternal pelvis, together with the acts of flexion, rotation, and descent which accommodate the head to the various diameters of the pelvis. So far as is known, the volume of the head is not changed but the shift in the position of the head alters its configuration. Whether the fixed bony points of the pelvis are shifted during the process of labor is subject to considerable controversy.

From the accompanying diagram (Fig 2), it is seen that, as one circumference or

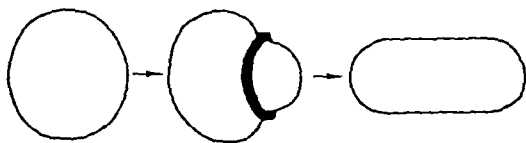


Fig 2 Changing shape of moldable spheroid

diameter of the spheroid is changed, the other changes accordingly. The volume of the spheroid is not affected. Theoretically, one diameter of the fetal head could be a point (actually the thickness of a cell), in which case the opposite diameter would approach infinity, a condition that is not compatible with life. Necessarily, one must arrive at the maximum limit of disproportion allowable in the various types of pelvis and fetal positions.

According to Ball and Marchbanks (4), the symphysis pubis is the fixed point from which all measurements in the mid-sagittal plane of the body are made. This assumption is valid when the symphysis, fetal head, and mid-sagittal plane of the sacrum coincide with the long axis of the film. Technically, it will be noted that in any given case of vertex presentation, the fetal

head, the symphysis, and the sacrum are projected simultaneously on a flat surface from varying object-film distances. It is not always possible to achieve the optimum of projecting these three points on the same longitudinal axis of the film.

In my experience, when the symphysis and sacrum do not coincide, the error relative to the fetal head volume is considerable. To reduce the error of magnification under these conditions, I have found it necessary to bisect the difference between the ventral and dorsal mid-sagittal planes, to arrive at the object-film distance for the lateral circumference of the fetal head. Furthermore, in order to find a more consistent locus for the measurement of the object-film distance of the fetal head in the anteroposterior and lateral projection, a point less subject to personal vagaries is ascertained if dividers are used to approximate the geometrical center of the fetal head rather than its equatorial plane.

In the case of breech presentation, in the ordinary anteroposterior projection, with the patient either standing or supine, the fetal head is distorted and magnified to such an extent as to cause poor delineation. These factors are further influenced by the range of motion of the fundus of the uterus. To correct these possible sources of error, the postero-anterior standing projection rather than the anteroposterior is used, together with a right or left lateral projection, depending on the position of the fetal head relative to the mother. The central ray is directed to the fetal head on the two smaller films. By this technic, the fetal head is closer to the film, easier to delineate, and subject to less distortion. In order to find a fixed point to correct for the object-film distance for the fetal head, it is necessary to place a metal marker on the most ventral portion of the mother's abdomen in the mid-line and to measure the distance to the table top plus the table top-film distance to arrive at the object-film distance. In the lateral projection, the corrected distance from the lead marker to the geometrical center of the head becomes the object-table top distance in the postero-anterior

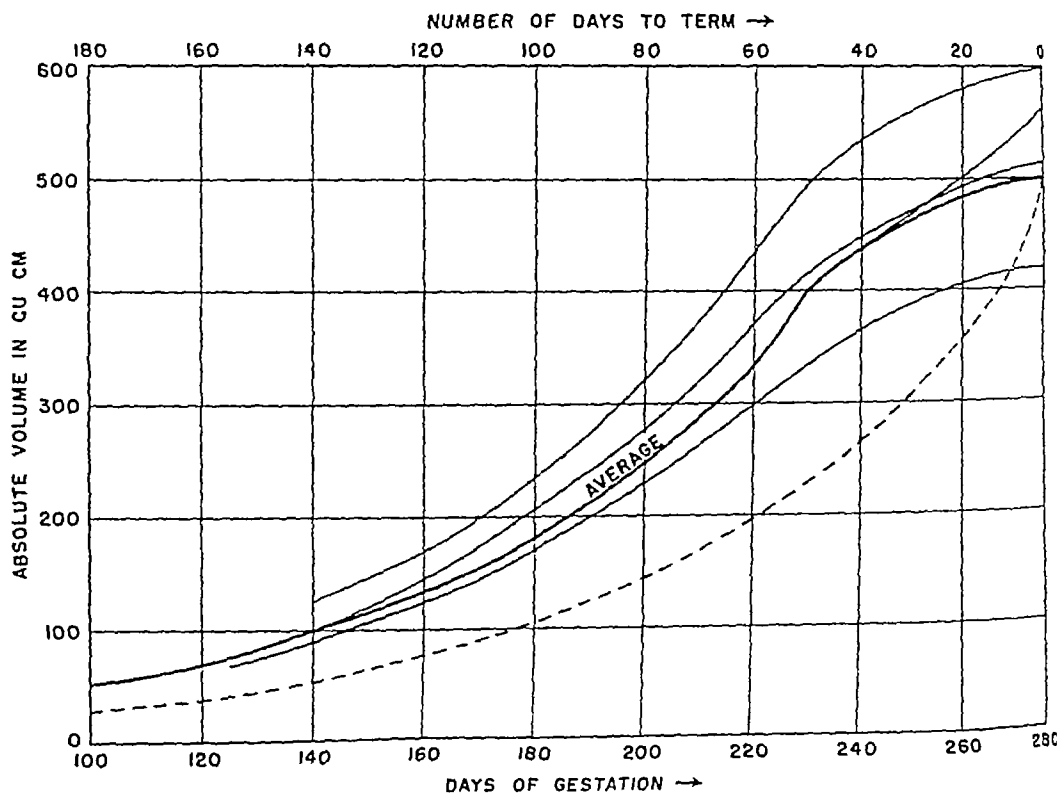


Fig 3 Absolute volume increase of fetal head in relation to days of gestation

view. A similar correction may be necessary in the lateral projection.

By the use of the lumbosacral pad, as described by Caldwell and Moloy (5), the inclination of the superior strait (with the patient in the supine position) has been approximately 30 degrees. Hence, by placing both anterior superior spines on the same horizontal plane (with the aid of a spirit level), tilting the tube 15 degrees toward the feet, and directing the central ray midway between the anterior superior spines, the superior strait is projected on the film and the obstetrical conjugate becomes the yardstick. It is evident that by this projection all diameters on the same plane will be magnified to the same degree and may be corrected by reduction to the known diameter, the obstetrical conjugate. The error known to exist by the use of this method is not objectionable, and this projection has been of value in the determination of the capacity of asymmetrical pelvis. Its use, however, is quite limited.

The crown-heel measurement, the occipito-frontal diameter, and the ossification centers are reasonably accurate indicators of fetal age. It must be admitted that these are sometimes difficult if not impossible to obtain from the film, due to the habitus of the fetus or to the inclination of the head. In any pregnancy, the size of the fetus is limited at conception by the volume of the fertilized ovum and at term by the mean volume of the fetal head, which fairly well parallels the fetal size and age.

The accompanying graph (Fig 3), based on 500 cases in which cephalopelvimetry was done by the modified Ball-Marchbanks technic described above, shows that if the absolute volume of the fetal head (volume without scalp) is plotted against the number of days to term (on the basis of 280 days gestation), a smooth curve results. From the available data, it appears that the absolute head volume is doubled about every forty-five days, up to about fifty days before delivery, at which point

the curve changes its slope. It is also noted that if the geometrical center of the head is below the obstetrical conjugate the ad volume increases at a lesser rate than the center remains above this line throughout pregnancy, up to the date of delivery. Needless to say, this method (except in the anencephalic fetus) is always applicable. It is relatively easy to obtain and in those cases in which such information has been of importance we have found this graph accurate, not only to ascertain the maturity of the fetus but also to determine the length of gestation and the probable date of delivery. This is the subject of further study to be reported later.

As shown on the graph, measurements taken on the delivered fetal head (average of the suboccipital-bregmatic and occipital-frontal circumferences, translated into terms of volume) were compared with measurements on the x-ray film ranging from 155 days before delivery and corrected to date of delivery. In this series the average error in the calculated head size as compared to the delivered head size has been ± 10 c c (or ± 2 mm in circumference). On the basis of the series studied, the method of Ball and Marchbanks (3, 4), as modified, seems to meet the requirements and limitations of a roentgen method of cephalopelvimetry on a practical basis.

The obstetrician is not particularly disturbed in those cases in which the pelvis is obviously adequate relative to the fetal head, nor is he especially concerned in those cases in which there is a cephalopelvic disproportion which can be evaluated clinically. It is the marginal case, in which the volume capacity of the various planes of the pelvis is about equal to or less than the volume of the fetal cranium, that is of interest to obstetrician and radiologist alike.

In our experience, the difficulty and duration of labor, as well as the incidence of operative assistance (manual rotation, version, forceps, cesarean section) increase as the disproportion between the fetal head and the smallest plane of the pelvis approaches 200 c c in the anterior and 135 c c in the posterior rotation. From the

radiological point of view, when disproportion of this extreme is manifest, it is imperative to inform the obstetrician that difficulty may be anticipated, so that an attempt may be made to find some method of compensating for the excessive disproportion. Further research may establish the exact volume disproportion allowable in the various types of pelvis, position, and presentation. Until such factors are definitely established, the radiological data should be limited to determining the cephalopelvic ratio and supplying information that may reduce the incidence of lasting injury to the mother and child.

CONCLUSIONS

1 A modification of the Ball-Marchbanks method of cephalopelvimetry is described.

2 In 500 cases studied at various intervals during pregnancy, the head measurements obtained from the roentgenogram and calculated to date of delivery, as compared to the measurement of the delivered fetus, showed an average error of ± 10 c c in volume or ± 2 mm in circumference.

3 A corrected growth curve is presented, showing the absolute volume of the fetal head *in utero* on the basis of this series.

4 A modified method of measuring the head of the fetus in cases of breech presentation is furnished, as well as a method of measuring the superior strait in asymmetrical pelvis.

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A Case of Acromegaly Presenting Specific Roentgenographic Changes¹

LT COL. JOHN H. GILMORE, M C, A U S, and MAJ THOMAS K. MAHAN, M C, A U S

OVERGROWTH of the vertebral bodies by direct increase in their transverse and anteroposterior diameters, and an overgrowth at the costochondral junctions, when present, are specific changes in acromegaly. Though these changes are easily demonstrated roentgenographically, either they are of rare occurrence or they have been neglected in the American radiologic literature. One paper, by Chester and Chester (3), appearing in 1940, deals with the subject.

The following case demonstrated the usual roentgenographic findings of acromegaly plus the unusual and specific spinal manifestations.

CASE REPORT

A white male, 31 years of age, was admitted to the hospital in January 1941, complaining of swelling of the second right costochondral junction and fever of three days' duration. Respiratory movements produced considerable pain.

The patient had injured his left hip in a tug-of-war in 1938, and since that time had complained of intermittent low back pain. He denied any noticeable change in his features and stated that his hands and feet had always been large and that he had difficulty in obtaining properly fitting gloves. The size of his hands he attributed to working with an air hammer. At the age of 19 he was 6 ft 2 in tall.

The patient's marital history was not remarkable. He had been married for nine years. There had been no children, presumably because his wife had a pelvic tumor. Libido had been normal.

The remainder of the history was irrelevant.

Physical examination showed a large, well developed, well nourished white male 6 feet 3 inches tall, weighing 235 pounds, with a typical acromegalic head and characteristic prognathism. Examination of the scalp revealed underlying irregularities that were considered to be parallel bone ridges. There was a red, warm, painful mass about 2 inches in diameter over the right second costo-

chondral junction.² Examination of the of the skeletal system was essentially negative. There was no limitation of motion in any of the joints. Reflexes were normal.

Routine laboratory tests, including carbohydrate tolerance, were within normal limits except for an increased sedimentation rate, ranging from 22 to 33 mm. The Kahn test was negative. Calcium, phosphorus, and phosphatase determinations were not made.

The significant roentgenographic findings were as follows. In the skull (Fig 1) there was marked thickening of all the bony plates, particularly the outer tables. The anterior wall of the frontal sinuses and the molar portion of the zygomata were unusually prominent. The hands (Fig 2) were the typical spade hands of acromegaly. The middle and proximal phalanges were broad, with cortical irregularity of the shafts. The metacarpals showed a similar though less marked change. There was "tufting" of the tips of the terminal phalanges. Examination of the upper right chest anteriorly (Fig 4) revealed a widening and beading of the chondral tips of the ribs visualized, the change being most pronounced in the third rib. In the lumbar spine (Fig 3) there was an apparent increase in the anteroposterior diameter of the bodies of the vertebrae, with moderate osteophytic formation on the anterior aspect of the opposing body surfaces. Lamunagraphy through the sagittal section of the lumbar vertebrae showed the increase in width of the bodies to be on the basis of new bone formation on their anterior aspects.

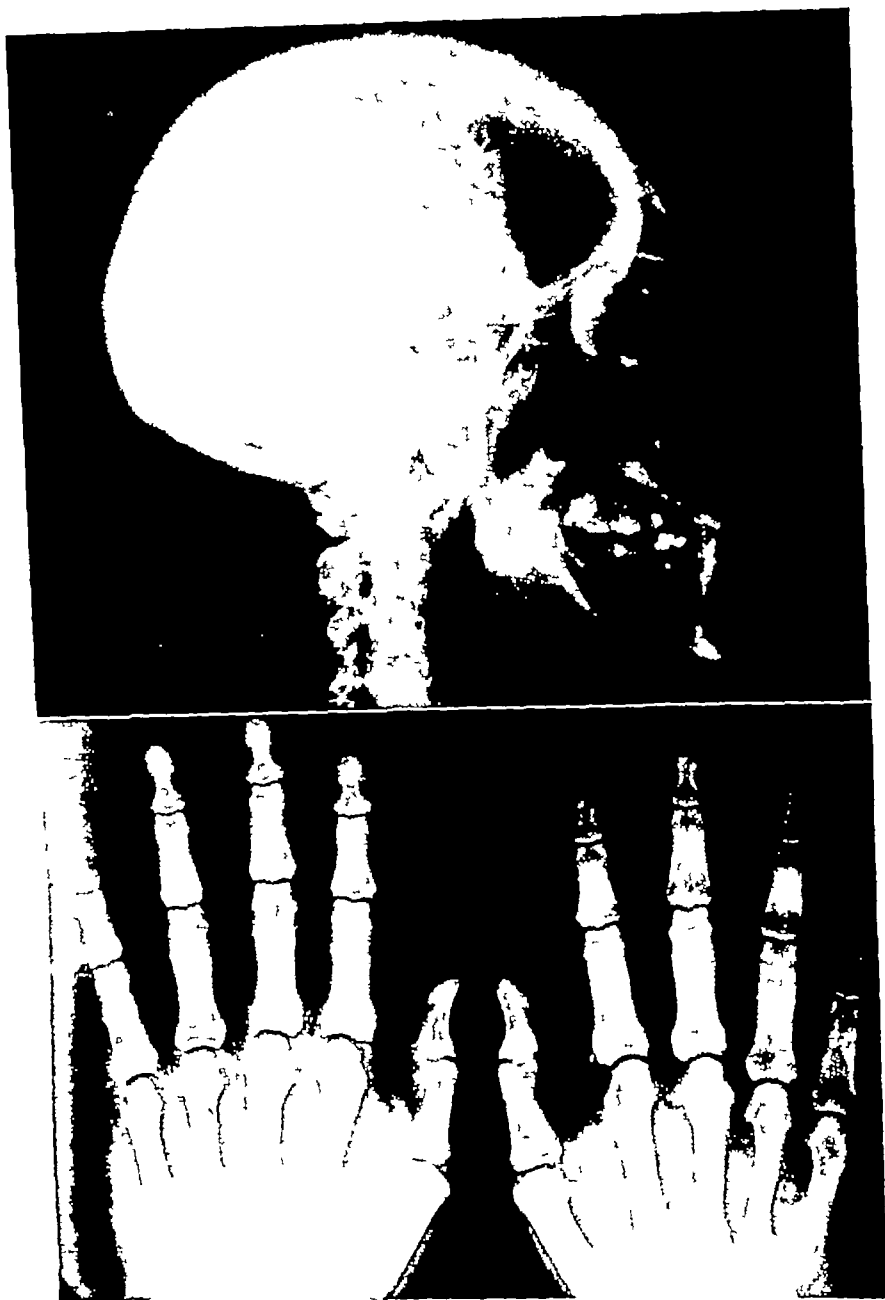
The patient's temperature gradually fell by itself, and the mass in the right chest wall disappeared. Tenderness in the area persisted, but was not as severe as on admission. During the stay of six weeks in the hospital there was a loss of 25 pounds in weight, for which no cause was found.

DISCUSSION

In 1931 Erdheim described specific changes in the vertebral column in a case of acromegaly, consisting of excessive growth of cartilaginous disks and vertebral bodies. He showed that the overgrowth took place at the lateral and anterior aspects of the bodies and intervertebral disks, resulting in a thickening of the column. In sagittal sections of the spine and in the lateral roentgenogram, he was

¹ Accepted for publication in December 1945.

² The focal manifestation of inflammation at the second right costochondral junction appears to have been coincidental. No direct inflammatory bone change was manifest at the involved site during the period of observation.



Figs 1 and 2 Roentgenograms of the skull and hands. The lateral view of the skull shows thickening of the tables more marked in the outer table and prominence of the malar portions of the zygomata. Definite involvement of the sella turcica could not be demonstrated.

The hands show broadening of the phalanges with cortical roughening of their shafts and 'tufting' of the tips of the terminal phalanges.

to distinguish between the original vertebral bodies, which presented a biconcave configuration, and the additional bone proliferation which extended directly from the anterior and lateral aspects. The

opposing aspects of the bodies anteriorly appeared flattened, with the concavities of the original bodies posteriorly placed. Similar proliferation of the cartilage of the intervertebral disks was observed. The

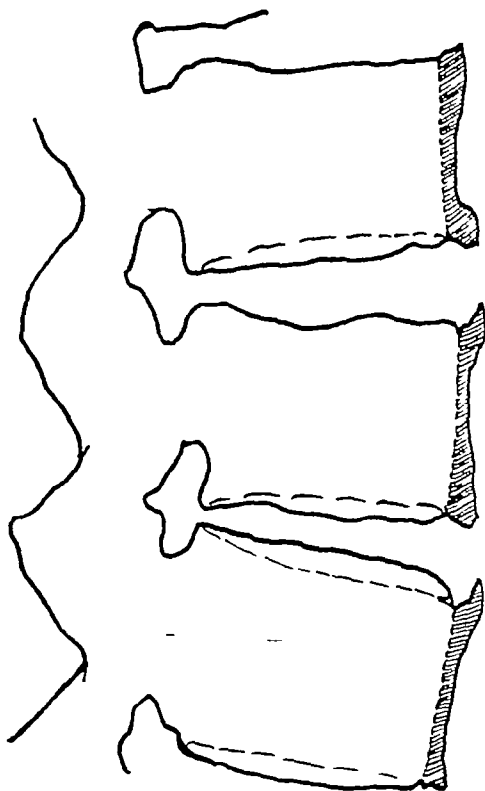


Fig 3 Lumbar spine L 2 to L 5 showing new growth on the anterior aspects of the lumbar bodies. Note that there is new growth along the entire anterior aspect of the bodies instead of localized periostosis at the tendinous and cartilaginous attachments such as occurs in degenerative bone lesions. The latter change however so called "parrot beaking" is superimposed on the new growth. The line drawing of the lumbar vertebrae demonstrates the extent of new growth which is represented by the shaded areas anteriorly.

nucleus pulposus of each involved disk seemed to be posteriorly placed. This was revealed by sagittal section of the spine at autopsy (1).

Schinz felt that vertebral thickening in the transverse and sagittal diameters was specific for acromegaly and could be easily demonstrated roentgenologically (2).

Chester and Chester reviewed the literature on this subject in 1940 and described the roentgen findings in the vertebral column in eight cases of their own. Five of their patients showed increase in the anteroposterior diameter of the dorsal vertebrae (3).

Waite, Bennett, and Bauer had the opportunity of making a postmortem study on an acromegalic who died of bacterial endocarditis. Roentgenograms revealed an enlarged sella turcica with thinning and

slight erosion of the posterior clinoid processes. The intervertebral articulations and dorsal vertebral bodies showed massive spur formations. The ribs showed moderate scalloping. At autopsy a pronounced fusiform widening of the ribs and irregular ossification of the costochondral junctions were observed. There was prominent lateral and anterior lipping of vertebral bodies at the margins of the disks. T 11 and 12 appeared slightly larger in transverse diameter than L-1 and 2. The vertebral changes, however, were not nearly so striking as those described by Erdheim. Waite and his associates were unable to determine whether these changes were definitely related to the specific articular lesions of acromegaly. They stated that they had not previously encountered microscopic lesions such as those ob-

erved in the costochondral cartilages. The following description is quoted directly from their discussion (4)

"The alterations consist of marked and irregular hyperplasia and hypertrophy of chondrocytes and increase in matrix in the middle cortical portions of the cartilaginous rib. Coupled with these phenomena is a progressive endochondral ossification of the cartilage bone border. The former are responsible for the prominent beading shown in the photograph of the patient and in the Roentgen ray film of the rib specimen (acromegalic rosary). The latter results in advance of the vascular bone marrow into the central avital part of the chondral cartilages and in increased periosteal bone formation at the periphery, so that for a short distance, two concentric layers of trabecular bone may be seen to envelop the former cartilaginous cortex. Thus, nodal as well as circumferential growth has occurred at the cartilage bone border and has led to the abnormal expansion of the thorax, long known as one of the striking characteristics of acromegaly. A comparison between our sections and those shown by Erdheim reveals close similarity in every essential detail."

CONCLUSION

A case of acromegaly is presented showing x-ray evidence of changes in the spine and at the costochondral junctions almost identical with those described by Erdheim (1), Chester and Chester (3), and Waite, Bennett and Bauer (4).

The overgrowth in the spine demonstrated in this case is specific for acromegaly. It should not be confused with other types of vertebral overgrowth associated with degenerative bone changes.



Fig 4 The anterior portions of the upper four ribs on the right are visualized. The widening and beading of the chondral tips are most marked in the first and third ribs.

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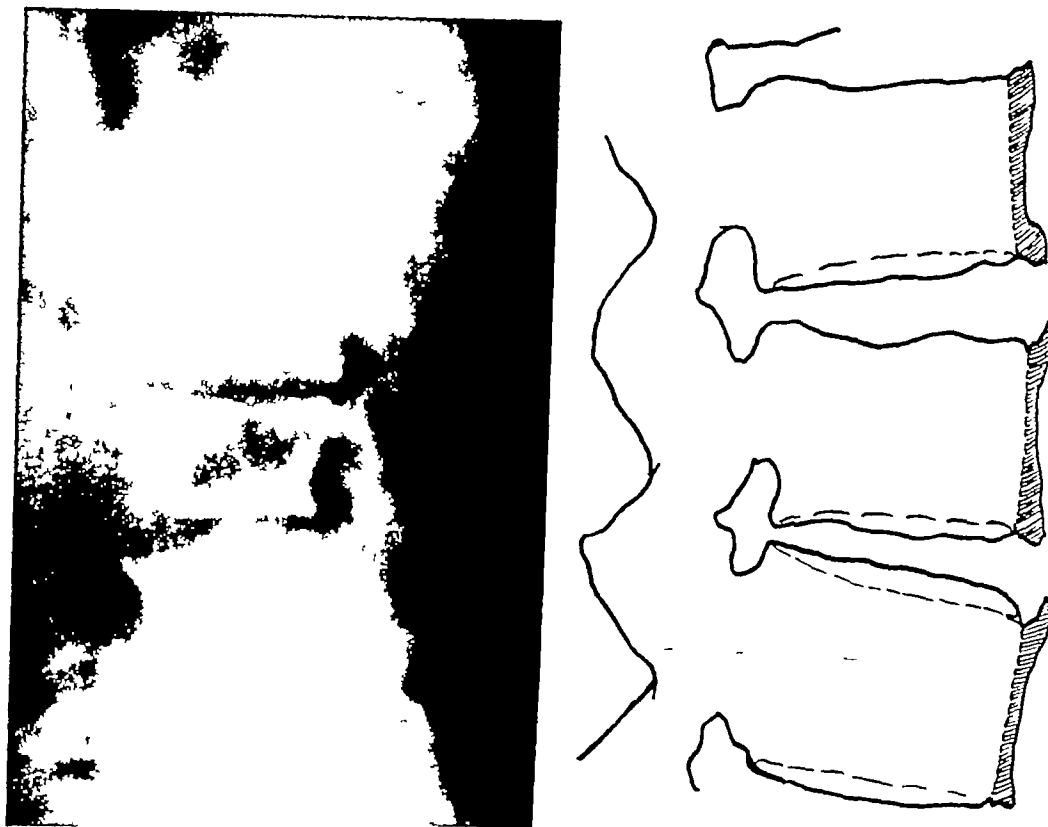


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Herniation of the Pericardium

Case Report¹

MAJ R Y GROMET, M C, A U S, and CAPT M J STEINBERG, M C, A U S

IT IS WELL KNOWN that with large pericardial effusions the pericardial sac expands backwards and compresses the left lung, resulting in an area of percussion dullness at the angle of the left scapula with bronchial breathing (Ewart's sign) and other signs

In the case to be reported here, an unusual feature presented itself. A hernia-like pericardial sac expanded and filled anteriorly to the left and extended above the left clavicle. With the patient erect, the pericardial sac would at times appear small or empty, but in the horizontal position it would fill immediately and occupy a large area in the upper left lung field, extending to the lateral chest wall. Simultaneously, the cardiac outline diminished slightly in its transverse diameter

A young male German prisoner of war had mild retrosternal aching and fever associated with an upper respiratory tract infection. A routine chest film revealed a startling configuration of the heart, with a rounded homogeneous density protruding from the region of the left hilum (Fig 1). Although the appearance of the shadow was typical of pericardial effusion, there was little clinical evidence of pericarditis or, indeed, of any cardiac abnormality. There was no dyspnea or tachycardia, and the heart tones were loud, clear, and normal.

The patient was observed at the Regional Station Hospital, Fort Sheridan, Ill., for several months after transfer from a nearby Army hospital. During his stay at Fort Sheridan he was in no distress. The pericardial effusion disappeared and reappeared several times. A pericardial tap was done, but no fluid was obtained. It was unfortunate that the tap was attempted at a time when the heart shadow was nearly normal.

Several x-ray and fluoroscopic studies of the chest were made. Figure 1 shows the cardiac shadow at the time of admission to the hospital. Figure 2 shows the change in the cardiac outline at

a later date, with the patient in the horizontal position. Figure 3 shows the heart shadow shortly before the pericardial tap was attempted. Figure 4 is the picture obtained before transfer to the Hospital Center, Camp Forrest, Tenn.

The etiology of this recurring pericardial effusion was not established. It is our belief that there was an underlying chronic serous inflammation of the pericardium associated with a large hernial sac. The sac probably arose from the vestigial falciform ligament of the serous pericardium, which passes from the left pulmonary artery to the left superior pulmonary vein. It was also felt that the ease with which the pericardial cavity could accommodate its increase to a large effusion explained the absence of clinical symptoms. Tuberculosis was considered as the most likely etiologic factor. The Mantoux test was positive. Other tests and electrocardiographic studies were of no particular help.

When the patient was transferred to the Hospital Center, Camp Forrest, Tenn., for return to Germany, he was symptomatically free, though the cardiac shadow was still somewhat enlarged. Communication with the roentgenologist there, Major Paul J. Wythe (who had the illustrations prepared) elicited the information that a second pericardial tap was not attempted. The effusion, however, had begun to reaccumulate late when the patient was returned to Germany.

The brevity of this report is occasioned by the failure to prove conclusively that fluid was present and that the shadow in the left chest was part of the pericardium and by the fact that the etiology was obscure.

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¹ Accepted for publication in February 1946



Figs 1-4 Successive views showing the changes in the cardiac outline. See text for details



Figs 1-4 Successive views showing the changes in the cardiac outline See text for details

Pneumographic Diagnosis of Intraventricular Epidermoid

Report of a Case¹

ARTHUR E. CHILDE, M.D., and ARTHUR W. YOUNG, M.D.

INTRACRANIAL epidermoids are comparatively rare, the reported incidence being somewhat variable, probably less than 1 per cent of all brain tumours. Intraventricular epidermoids are even less common but, when present, produce a charac-

appearance in the encephalogram of irregularly shaped collections of gas distributed through that portion of the right middle fossa normally occupied by the thalamus, island of Reil, temporal lobe, and posterior portion of the frontal lobe. There was

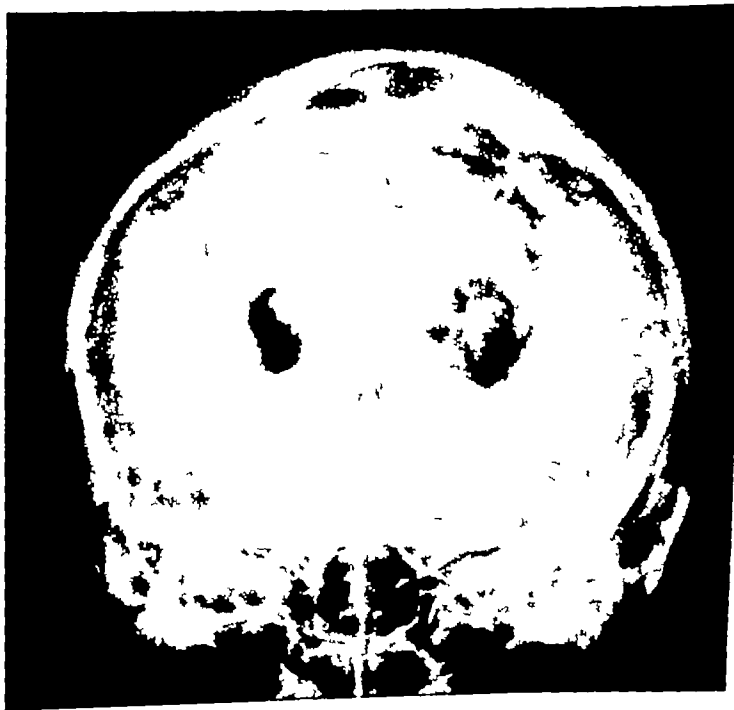


Fig 1 Anteroposterior ventriculogram. The anterior portions of both lateral ventricles are almost completely filled by tumour tissue but their posterior portions and the temporal horns are well shown.

teristic pneumographic appearance which cannot easily be mistaken for any other lesion. This was first noted by Krieg (1), in 1936, who published two such cases, in one of which he observed irregular rounded shadows in the ventricle.

Quite independently, in 1937, Dyke and Davidoff (2) reported a large right intraventricular epidermoid cyst which was successfully removed. They described an

slight lateral displacement of the ventricular system, and the right frontal horn and the anterior portion of the lateral ventricle were elevated. Dyke (3) later reported a similar case in which the tumour was situated in the posterior thirds of the lateral ventricles and again he noted large irregular streaks of gas which passed through the substance of the tumour and the area of brain normally occupied by the splenium

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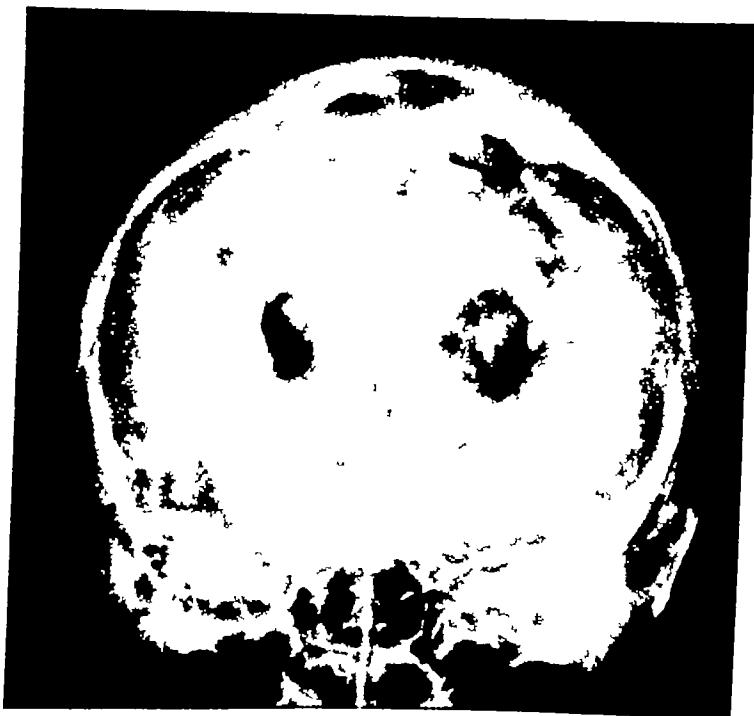


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of the corpus callosum. He felt that this was due to folds in the walls of the tumour.

Weinberger (4) reported two more cases in 1938, one of them verified, and he remarked upon the "sponge-like" appearance after gas injection.

Peyton and Baker (5), in 1942, reported 14 cases of epidermoid and teratomatous tumours of the central nervous system, one of which was an intraventricular epidermoid. The encephalogram in this instance revealed a large cystic area partially

preoperatively, it is felt to be worth while to report the following case, as it shows the typical pneumographic features of an intraventricular epidermoid that progressed to an extreme size. Except for the progression of the symptoms and moderately raised spinal fluid pressure, an expanding intracranial lesion would not have been suspected. In fact, at different times in the illness such diagnoses as hysteria, disseminated sclerosis, and Parkinson's disease were considered.



Fig 2 Lateral view with the brow up. This was made without moving the patient and the distribution of the oxygen corresponds with that in Figure 1. The furrowed appearance of the tumour is well shown, also the marked upward extension toward the bregma.

filled with air and partially with tumour, situated in the region of the right parietal and occipital lobes and occupying the ventricle but extending far beyond its normal confines. There was displacement of the left lateral ventricle to the left.

In view of the comparatively small number of such cases in the literature diagnosed

CASE REPORT

I D., a 37 year-old white female, was admitted to the Montreal Neurological Institute on Oct. 1, 1944, complaining of weakness of the legs and difficulty in walking. For fifteen years she had been employed as a clerk in the office of a large insurance company without missing a day from work on account of illness. In September 1943 she noticed some difficulty in descending stairs, getting on and off busses and

stepping up onto the curb then became difficult, and soon her walking on the level was awkward and uncertain. If she ran, when in a hurry, she could not stop and would fall forward on her face unless she could catch hold of something to stop herself. In January 1944 she gave up going to the office because her walking was so poor and she was so unsteady. About the same time her writing deteriorated, sometimes being almost illegible. Coordination of fine movements with the right hand was poor, and a fine tremor of the hand developed. The patient complained of some numbness and loss of strength in

variable, sometimes present and at other times absent, and only brought out on gaze to the left. There was slight asymmetry of the face with a lag of the left corner of the mouth on voluntary movement. Speech was slow and slurred and writing was jerky. Rotation of the hands was done poorly, yet all other movements of the hands were quite good. There was no intention tremor. Strength in the upper and lower extremities was good. All the deep reflexes were greatly exaggerated. The abdominal reflexes were present. The plantar responses varied. Early in the illness a right extensor



Fig 3 Postero-anterior view. The posterior portions of the ventricles are somewhat more completely visualized but otherwise the appearance differs little from the anteroposterior view.

the right hand and of frequency and urgency of micturition. She thought her vision had deteriorated but she did not suffer from headache or dizziness.

The striking finding on repeated examinations made early in the illness, and while the patient was under observation in the Institute, was the great disturbance in gait. Her steps were short and shuffling and her feet seemed glued to the ground. She walked slowly and, when standing alone, tended to fall backward. When one took her arm, however, or even held the sleeve of her dress, she walked with assurance and confidence, taking normal steps.

There was a mask-like expression of the face and a gentle forward stoop of the body. The fundi were normal and the fields of vision full. Nystagmus was

plantar response (positive Babinski sign) was noted. Later both plantar responses were reported as flexor and while the patient was in the Institute both were found to be extensor. The only sensory change was diminished vibration sense over the right arm and leg.

Plain radiographs of the skull made on Oct. 5, 1944, showed some increase in the thickness of the inner table of the frontal bone with moderate irregularity. The sella turcica was not deformed and there was nothing to indicate increased intracranial pressure. A blood Wassermann test was negative and there was no anemia. A lumbar puncture showed the spinal fluid pressure to be 250 mm of water. The Pandy test was negative and the total

protein measured 21 mg per 100 c.c. The Lange curve read 1222110000 and the Wassermann reaction was negative.

It was the finding of the moderately raised spinal fluid pressure which prompted encephalography on Oct. 11. This failed to visualize the lateral and third ventricles, but it showed the fourth ventricle, which was small and not displaced. Subarachnoid markings were present in the right frontal region and there seemed to be partial visualization of the callosal sulcus, which presented a wide curve suggesting dilatation of the lateral ventricles. The inter-

portions of the ventricles were almost filled by soft-tissue masses, through and around which multiple furrows containing gas were visible. The soft-tissue masses were approximately equal on the two sides and extended well posteriorly in the ventricles, although not so far as the occipital horns. The third ventricle was poorly visualized but it appeared to contain a small amount of oxygen in its inferior portion (Figs 1-5).

The radiographic impression was involvement of both lateral ventricles and probably the third ventricle by a huge intraventricular epidermoid.



Fig 4 Lateral view with the occiput up. There is seen to be enlargement of the posterior portions of the ventricles but the tumour does not extend much further backward than the usual position of the glomus of the choroid plexus.

peduncular cistern was small and compressed from above. It was felt that these findings suggested a block, presumably above the fourth ventricle, and a ventriculogram was advised.

Ventriculography, Oct. 28, showed the posterior portions of both lateral ventricles to be dilated and revealed similar enlargement of the temporal horns. The lateral ventricles did not extend much further forward than usual, but their anterior parts on both sides were so much enlarged upward that they reached to within 1.5 cm. of the inner table of the skull in the neighbourhood of the bregma. These

On Oct. 29, 1944, Dr W. V. Cone performed a bifrontoparietal osteoplastic craniotomy of the free-bone-flap type and, so far as he could tell, completely removed the tumour, which was a typical epidermoid or pearly tumour of Cruveilhier. It was very extensive, partially filling the lateral and third ventricles, and presenting itself nearest the surface at the free margin of the falx cerebri. The thin capsule lay in folds or accordion-like pleats, and when traction was made on the capsule the pleats unfolded, leaving added folds behind. There was much cheesy material and in all 41 gm. of tumour tissue were re-

stepping up onto the curb then became difficult, and soon her walking on the level was awkward and uncertain. If she ran, when in a hurry, she could not stop and would fall forward on her face unless she could catch hold of something to stop herself. In January 1944 she gave up going to the office because her walking was so poor and she was so unsteady. About the same time her writing deteriorated, sometimes being almost illegible. Coordination of fine movements with the right hand was poor, and a fine tremor of the hand developed. The patient complained of some numbness and loss of strength in

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plantar response (positive Babinski sign) was noted. Later both plantar responses were reported as flexor and while the patient was in the Institute both were found to be extensor. The only sensory change was diminished vibration sense over the right arm and leg.

Plain radiographs of the skull made on Oct. 3, 1944, showed some increase in the thickness of the inner table of the frontal bone with moderate irregularity. The sella turcica was not deformed and there was nothing to indicate increased intracranial pressure. A blood Wassermann test was negative and there was no anemia. A lumbar puncture showed the spinal fluid pressure to be 250 mm. of water. The Pandy test was negative and the total

An Unusual Roentgen Shadow in Chloroma¹

J MAXEY DELL, JR, M D

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THE CLOSE correlation between the roentgen and autopsy findings prompted the report of the following case

A colored male, 28 years old, was admitted to the hospital with evidence of a debilitating disease and was referred to the Department of Roentgenology for



Fig 1 Roentgenogram showing shadow adjacent to and merging with the bodies of the thoracic vertebrae (Photo by U S Army Signal Corps)

examination of the sternum. Films showed a destructive process in the inferior segment of the gladiolus. A biopsy had been performed at this point several weeks previously, but the destruction was too extensive to be the result of that procedure. A shadow of unusual clarity was observed adjacent to and merging with the bodies of the thoracic vertebrae (Fig 1). This density was localized by fluoroscopy and oblique films in the posterior portion of the mediastinum. A soft-tissue mass was demonstrable anterior to the defect. These findings suggested tuberculosis as the etiological factor.

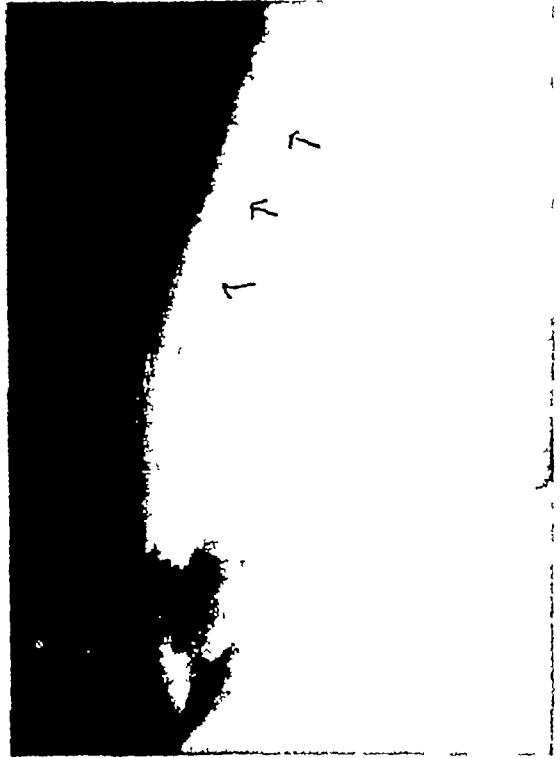


Fig 2 Lateral view showing soft tissue mass of fairly uniform thickness behind the sternum

In this department oblique films of the sternum are made with a long exposure time with the patient breathing. The respiratory motion results in a blurring of the lung, mediastinal and rib detail, but the significance of this was not appreciated at the time of this study.

Roentgen examination of the spine, long bones, and skull revealed no abnormalities. A lateral film of the sternum showed behind it a soft-tissue shadow of fairly uniform thickness (Fig 2).

After rather extensive laboratory studies, a clinical diagnosis of monocytic leukemia was made. Details of the history, physical examination, and laboratory findings need not be recounted here, as they contribute nothing to the primary purpose of the report, namely, the analysis of an unusual roentgen shadow.

The patient expired in a few weeks. Autopsy revealed massive infiltration of the periosteum of the sternum, ribs, and vertebrae, the parietal pleura, and the thoracic and periaortic lymph nodes by a greenish tumor tissue, with lesser infiltrations of the

¹ Accepted for publication in December 1945



Fig. 5 Right lateral view. The temporal and occipital horns on the left are well shown, as are the accordion like plaits of the tumour. Note the normal sella turcica.

moved. When the removal was seemingly complete both lateral ventricles, both choroid plexuses, and the entire third ventricle were completely exposed. No corpus callosum was identified at any time. During the course of the operation it was necessary to clip several large cortical veins on the left side as they entered the median longitudinal sinus, as well as a rather large artery on the mesial surface of the brain.

The patient stood the operation well, but the post-operative course was exceedingly stormy. Consciousness did not return for days, and the picture was not unlike that of decerebrate rigidity. Gradually the decerebrate posture improved, but never entirely cleared. The patient did not speak until Feb. 27, 1945. She was discharged on March 17, by which time there was some voluntary movement of all her limbs, but spasticity was pronounced and there were some contractures. Her speech by this time was clear and distinct, and mentally she was quite alert. She died shortly after leaving the hospital.

The pathological examination of the tumour showed it to be a typical pearly tumour, an epidermoid (cholesteatoma).

SUMMARY

Intraventricular epidermoids produce characteristic pneumographic deformities so that preoperative diagnosis is easy. In a large series of cases of intraventricular epidermoid with typical findings is reported.

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The Range of Usefulness of Intravenous Pyelography¹

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SINCE 1929, when von Lichtenberg and his associates introduced the practice of clinical excretory urography, it has steadily progressed in usefulness. It has been most interesting to read over some of our earlier reports of this type of examination and to observe the widening scope of the procedure throughout the subsequent years.

During the first few years, the most rapid development was in the examination of young children. This was due largely to the difficulty of instrumentation and also to the fact that our sphere of interpretation was still limited to the more gross pathological and anomalous findings. With further refinement of contrast media and improvement in the preparation of the patient, plus correlation of the clinical pathology and functional physiology, the field of usefulness of this procedure has rapidly widened.

During the first five years, we used in our laboratories all the different media, with varying success and not too few untoward side effects. Since 1935, we have used only diodrast, and because of its low toxicity and absence of irritative action on the tissues, we have been able to direct our chief attention toward its useful application rather than to avoidance of unfavorable reactions. Patients and co-workers, also, are less reluctant to accept or request examination with this medium. From 1935 to 1945, 1,515 examinations were made, with no deaths attributable to the procedure. We have taken a fairly careful history as to asthmatic attacks, hay fever, urticaria, and anginoid pains, and in all suspicious cases, and a fair percentage of others, have given a trial injection of 30 to 50 c c into the vein. If after five minutes no reaction

ensued, the injection was completed. We have not failed to complete the injection in a single instance.

Preparation of the Patient The preparation of the patient has been fairly well standardized in printed forms, requiring only minor changes in the amount of laxative to be used and the time of its administration. The purpose of the preparation is to dehydrate the patient, to cleanse and "de-gas" the intestinal tract. The laxative effect must be timed as nearly as possible so that only a short interval will occur between purgation and examination, as otherwise gas will reform in the intestine. The laxative used is compound licorice powder, and instructions are given for the limitation of fluid intake over a period of twelve to sixteen hours preceding the examination.

Procedure of Examination The following procedure is used routinely and is applicable in all but a small percentage of cases. After a satisfactory scout film is obtained, the injection is made, rarely with more than 20 c c of the 35 per cent iodized medium. Exceptions are very obese persons, weighing 200 pounds or more. In our experience, concentration of the urine by dehydration of the patient has been more effective than the use of large amounts of the contrast substance. In only the extremely heavy patient is as much as 30 c c given, and even then there is no set rule of ratio of volume to weight.

The first five minutes will normally determine the functional thrust of the kidneys. The more normal the function, the faster the clearance. In children, the period of maximum concentration is at the five-minute interval. In adults up to fifty years of age, the normal period of maximum

¹ Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill, Nov 8-9, 1945.

² Deceased

heart, lungs, liver, spleen, kidneys, prostate, skin, stomach, appendix, and numerous areas in the muscles and interstitial tissues. The thoracic vertebral bodies were encased in this tumor tissue, which gave the appearance of candle drippings. All of the tumor tissue was composed of solid masses of closely packed large mononuclear cells supported by a minimum of stroma.

Pathological Diagnosis Chloroma in a case of monocytic leukemia

COMMENT

1 In this case, if the blurring effect of respiration is properly evaluated, the roentgen diagnosis of a tuberculous process was illogical. Respiratory movement will blur all mediastinal shadows to some extent, even the shadow of the barium-filled esophagus. The long exposure time is enough to allow pulsation to blur any vascular shadow. It would be unusual for a cold abscess to be present without involvement of the vertebrae. With these

facts in mind, the following statements appear logical

- (a) The density is very close to and connected with the vertebrae, which act as anchoring points
- (b) Mediastinal masses due to tumor, enlarged lymph nodes, aneurysm, etc., could not produce a sharply defined shadow with the technique employed
- (c) A cold abscess would be unlikely without changes in the vertebral bodies

CONCLUSION

This unusual shadow was proved by autopsy to have been produced by tumor tissue encasing the spine. It is hoped that this report will allow proper evaluation of future shadows of this nature

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the retrograde cystographic procedure. Diverticula of the bladder, abnormal prostatic indenture, and intrinsic lesions of the bladder wall may be revealed. By having the male patient void, the presence or absence of retention may be determined.

CONCLUSION

Diligent application of excretory urography may permit a wide scope of interpretation of kidney and bladder lesions. The requirements are (1) careful preparation of the patient, (2) individualized attention to the functional status of both kidneys, (3) production of proper ureteral compression at the period of maximum clearance thrust, with cortical measurements of both the normal and affected sides to aid in evaluating and differentiating the acute from the chronic uropathies, (4) a more complete ureteral study, (5) use of a concentrated medium for cystography.

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concentration is found at about fifteen minutes, while in the aged it is usually later

Observations Pathological alterations in clearance are of three types

(1) *Acute mechanical suppression*, such as is found in ureteral stone obstruction. In the presence of obstruction of this type, the renal parenchyma shows considerably more concentration of the medium than does the unobstructed kidney. There is no associated cortical thinning of the affected side, nor any compensatory hypertrophy of the unaffected kidney

(2) *Chronic mechanical obstruction*, such as may be found in the presence of long-standing ureteral stones, anomalous vessels at or near the ureteropelvic junction, or tumors causing pressure and thereby interfering with drainage, diffuse lipomatosis of the kidney hilus, and primary ureteral lesions. In chronic obstruction, the functional thrust of the affected kidney may be delayed for one or more hours in advanced cases, and there will be more or less cortical thinning associated with varying degrees of pelvic dilatation. In advanced cases the cortex will be but a few millimeters in thickness, as compared with a thickness in the adult of 2.0 cm. when the measurements are taken from the cups of the calices to the peripheral margin (the tube distance being 36 inches). There will also be found compensatory hypertrophy of the cortex of the opposite kidney, as well as compensatory function, in patients not having nephritic disease

(3) *Nephritic involvement without mechanical obstructive uropathy*. In this condition there will be poor concentration on both sides throughout a long period of clearance, without ureteropelvic distention. This finding may, however, be unilateral, constituting an etiological Goldblatt syndrome of hypertension

At the period of maximum thrust, which usually is at the fifteen-minute interval, bilateral ureteral compression is made over the sacroiliac areas by means of tightly folded pillow slips and a strong compression band. The folded pillow slips are arranged, one on either side, with a two-

finger-width space between them in the mid-line. Compression is maintained for five minutes, at the end of which time we usually find the proximal half of each ureter and the pelvis and calices of each kidney filled to distention if no organic lesion is present. The presence of a diffuse or localized pyelonephritis will be evidenced by lack of distensibility, and there may be other, more advanced defects, depending upon the type and stage of the lesion. The early discovery of pyelonephritis, before destructive changes have ensued or calculi have formed, is of the utmost importance

Ureteral Study During ureteral compression, a complete study of the ureters usually may be made. Detection of ureteropelvic deformities, with evidence of some pelvic stasis, would suggest the advisability of a standing film to determine the possibility of a fixation point at or near the ureteropelvic juncture, not infrequently an anomalous vessel is found. Ureteral kinks and unusual excursion of the kidneys not producing a disturbance in drainage are not considered pathological by our associated urologists. Such anomalies as megalo-ureter, double ureter, and ectopic kidneys, are usually effectively studied at this interval. With sudden release of the compression, the distal portions of the ureters are usually well filled immediately, but the filling may be delayed 20 to 40 seconds, depending on the muscle tone of the pelvis and ureters. When there is evidence of flaccidity during the examination, a longer interval should be allowed before taking the distal ureteral film or films. With the distal ureters well filled, pelvic relationships may be studied. Intrinsic ureteral disease may be found, as ureterocele and other primary lesions

The Bladder Except in those cases with very poor kidney function or very high fluid level in the body, a diagnostic cystogram is obtained. When multiple positions—anteroposterior, postero-anterior, and right and left latero-oblique—are employed, information furnished by the intravenous method is as accurate as that obtained by

plasia started in the transitional zone of the cartilage, and areas of liquefaction subsequently developed. This was at times followed by calcification. When calcification did not occur, the areas of liquefaction broke down and ulcerated.

To the above known localizations of calcification and ossification occurring in acromegaly, we wish to add a report of similar involvement of the auricles of the external ear in a long-standing case.

At the present time physical examination reveals a typical acromegalic facies, kyphosis, and spade like hands and feet. General motor weakness is a prominent symptom, the skin is pale, and hair is absent from the chest, abdomen, and axilla. The voice is slow, indistinct, and high-pitched. The supra orbital ridges are prominent, the eyebrows are almost absent and the palpebral fissures are narrow and slit like. Examination of the eyes reveals bilateral cataracts. The lips are thick and bulging, and the mouth and tongue are enormously enlarged. The ears are likewise enlarged, displaced upward and backward, and are rigid. The chest is barrel-



Fig 2 Roentgenogram of skull showing enlarged sinuses, thickened tables, and protruding mandible. The sella is not enlarged.

CASE REPORT

B. R., a 63-year old textile dealer, first exhibited symptoms of acromegaly thirty years ago, when he noticed that his hands were becoming gradually larger and his facial features distorted. He consulted Dr. Harvey Cushing, and a definite diagnosis of acromegaly was made. Surgery was suggested but refused. The patient subsequently received a course of radiation therapy to the pituitary gland at the Post Graduate Hospital in New York. He was then able to continue with his work for the following fifteen years, although symptoms became more pronounced.

shaped, and there is a marked kyphosis. The angle of Ludwig measures about 90 degrees. The heart, lungs, and abdomen appear normal. Both hands and feet show typical acromegalic enlargement, with spade-like deformities. There is limitation of motion in both hips on rotation and abduction. Both knees show a diffuse round swelling, with extreme pain on attempts at extension. Both legs are kept in flexion at about 90 degrees.

In addition to the advanced evidence of acromegaly as manifested by marked enlargement of the sinuses, protuberance of the mandible, the spade like hands and feet, etc., roentgen study of this patient

Ossification of Auricles of External Ears

Associated with Acromegaly¹

LOUIS NATHANSON, M D, M Sc (Med), and SAMUEL LOSNER, M D

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IN 1931, J Erdheim (4) first showed that the cartilage in acromegaly undergoes changes of both a proliferative and degenerative nature. The examples cited in his study are the cartilages of the ribs and vertebrae. The pathological process con-

According to Erdheim, this process of calcification and ossification may take place in the ribs and intervertebral disks in acromegaly. Another localization of these proliferative and degenerative changes in the cartilage of acromegalics was observed

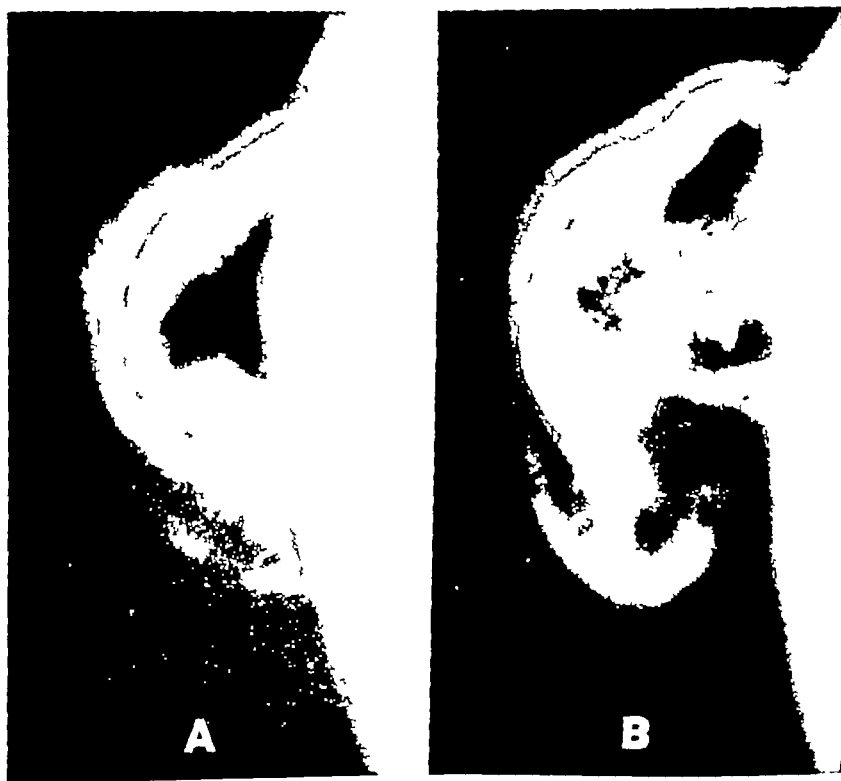


Fig 1 Ossification of the auricles of both ears. A Right ear. B Left ear.

sisted of an increase in cartilaginous cells and intercellular substance, leading to a distention of the transitional zone between bone and cartilage. Proliferation was followed by degeneration with liquefaction and formation of vacuoles which were filled with deficient cartilaginous tissue. Later, ossification took place with or without previous calcification.

by H v Meyenburg (5), namely, the trachea and larynx. To his knowledge, his was the first such report.

Experimental evidence of the action of anterior pituitary extract of cattle upon the articular cartilage of guinea-pigs was published by Silberberg in 1936 (6). He produced what he called an "acromegalic arthropathy." Hypertrophy and hyper-

¹From the Department of Radiology, Jewish Sanitarium and Hospital for Chronic Diseases, Brooklyn, N Y. Accepted for publication in December 1945.

EDITORIAL

The Thirty-Second Annual Meeting The Scientific Program

Something like a tidal wave swept into the Palmer House, Chicago, the first week in December, when over 1,400 radiologists and 237 exhibitors and speakers assembled for the Thirty-second Annual Meeting of the Radiological Society of North America. The Program Committee, whose job is never an easy one, deserves the highest praise for the fine scientific sessions that they arranged. It is doubtful if a program containing so many significant papers has been presented since the earliest days of the development of Radiology.

After a cordial welcome from Dr. Robert S. Berghoff, President of the Illinois State Medical Society, the formal program opened on Monday morning, Dec. 2, with a prophetic note. The President's address, "Radiology and the Future," was given by Lowell Goin in his own polished and inimitable style. He sounded a warning and offered good advice about the future developments in economic and social conditions of radiologic practice. His words should be heeded, for there is none who understands the problems better than he, or is more competent to meet them.

The rest of the first day was devoted to a masterly symposium on the Plutonium Project, presided over by Austin M. Brues, Director of the Argonne National Laboratory and Associate Professor of Medicine, University of Chicago. The speakers came from Maryland to California. Their subjects ranged from a description of the pile to the histologic changes following irradiation. While much of the material was beyond the grasp of many of us in the audience, a little knowledge filtered in to form a foundation for future growth. The importance of this symposium is great, for it presented a mass of biological and physical

facts from a new source that is undoubtedly going to change our methods of practice, our knowledge of physiology, and no doubt our daily lives. This, the first lesson, while it sounded hard as it came over the microphone, should be invaluable when we have a chance to study the papers as they are published.

A fitting climax to the day came at the Membership Dinner, when the Gold Medal of the Society, awarded for the first time since 1941, was presented to Robert S. Stone for his work on the atom bomb project and its application to medicine. As Chief of the Health Division of the MED project, for the Manhattan Engineer District, Army Service Forces, Dr. Stone was in charge of essential research and investigations of the radiation hazards involved in the operation of the entire project.

Some of the fission products of Monday's program scattered over into succeeding days. Of particular importance was a paper on the "Application of Radioactive Isotopes to a Study of Radiation Effects in Cells," by Martin D. Kamen, Ph.D. This paper will require careful study, with, as the discussants pointed out, a dictionary at hand. Other high lights of the second day were two papers on catheterization of the heart by Merrill Sosman and L. Dexter, presenting for the first time to radiologists this valuable means of study in the physiology and diagnosis of congenital heart disease.

The Therapy Section on the second day was treated to a panel discussion and round table forum on the subject of Carcinoma of the Cervix, a beautifully integrated performance presided over by Edwin Ernst. The sense of this symposium was that the treatment is still in a state that permits

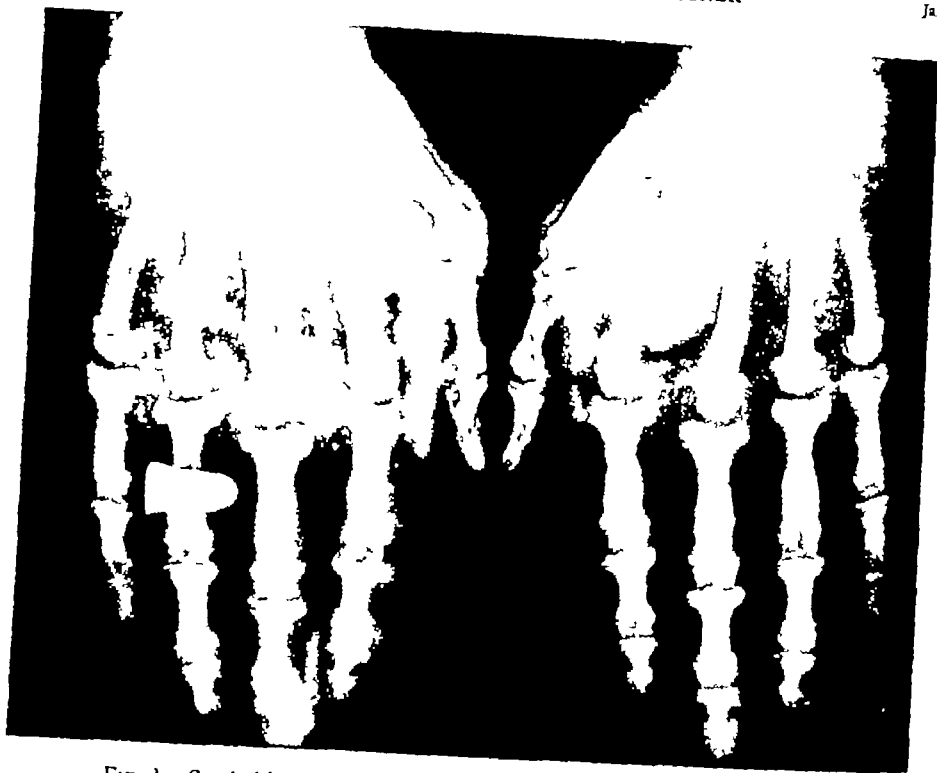


Fig 3 Spade like hands with tufting The feet were similarly involved

demonstrated the unusual finding of calcification or ossification of both external ears. The finding was similar on both sides, and the entire cartilage was apparently involved. The roentgenograms of the external ears were readily obtained because of the rigidity of the auriculae and the manner in which they extended from the skull.

It is our impression that the findings in this case indicate ossification rather than calcification, because of the trabeculated structure present. The ossification occurred in a way to differentiate clearly the individual portions of the cartilage of the auricula. The cartilage normally consists of a single piece and gives form to the ear, and upon its surface are found the eminences and depressions which we recognize as the normal ear contour. Cartilage is normally absent from the lobule. The roentgenograms demonstrate the various portions of the cartilage clearly. The rim of the helix and antihelix, the fossa triangularis, and concha are clearly outlined. It is our impression that the entire cartilage

on both sides is ossified. The lobule of the ear, where no cartilage is present, is uninvolved.

SUMMARY

A case is presented to demonstrate ossification of both external ears associated with advanced acromegaly.

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DR. ROBERT S STONE

Recipient of the Gold Medal of the Radiological Society of North America 1946

In awarding the Gold Medal Dr Lowell S Goin President of the Society, said in part Dr Stone Director for Health of the Plutonium Project, had the complete responsibility for the health of all persons employed in this gigantic undertaking and not only for these but for all those who lived in the immediate vicinity and for those who lived on tributary waters in areas where the reacting piles were located. Because Dr Stone is a student and a scholar because he is a wise man and an experienced clinician he was able to serve the Government and the people in this tremendously important capacity and in so doing he has reflected glory upon every one of us, he has added to the prestige of our profession, he has notably increased the stature of radiology "

improvement Early diagnosis and early treatment are important The method to be used depends upon the skill available, that combination of methods which can be administered with the greatest understanding and experience will produce the best results

The Carman Lecture was delivered Tuesday evening by Robert R Newell, who took as his subject "The Quality of Radiation in Therapy" Dr Newell mixed physics and humor in a manner both informative and amusing, demonstrating by the high scientific quality of his contribution and his sparkling wit that the choice of lecturer had indeed been well made

Following Dr Newell came an unscheduled presentation, moving pictures of the Bikini bomb test, with some slides and significant remarks by Col Stafford Warren and Col James Cooney This was a sobering experience We cannot but be grateful for this chance to visualize more clearly the awesome potentialities of the bomb, and to realize more fully that the possibilities of destruction are as great if not greater than the scientific promise offered by the research that produced it

The evening closed with a delightful party, at which we were the guests of the Chicago Roentgen Society

Wednesday we settled down to more familiar things Among the excellent papers on that day were "Experimental Clostridial Infections in Dogs," by Andrew H Dowdy, and "Thoracic Angiography," by Dr Carlos Gomez del Campo and Dr Jorge Meneses, of Mexico City An interesting symposium was presented in the Therapy Section on the "Care of Advanced Cancer Patients," presided over by Herbert H Murphy of Victoria, British Columbia

Thursday produced many important papers, starting off with "Medical, Biological and Industrial Applications of Monochromatic Radiography and Micro-radiography," by George L Clark, Ph D, of the University of Illinois Another paper opening up for us new possibilities was "Development of the Betatron for Electron Therapy," by L S Skaggs, G M

Almy, D W Kerst, and L H Lanzl, of the University of Illinois Two further special papers appeared, one by Dr Nils Westermark, of Stockholm, Sweden, on "The Importance of Alveolar Pressure in Diagnosis of Pulmonary Disease," and the other by Dr Leonardo Guzman, of Santiago, Chile, on "Cancer of the Thyroid" Another of the newer diseases was offered for us to worry about by David V LeMone, Wendell G Scott, Sherwood Moore, and Capt. A Link Koven, "Bagasse Disease of the Lungs"

New material was not exhausted by Friday On the diagnostic side we heard about "Studies of Tetraiodophthalimido-ethanol as a Medium for Gastro-Intestinal Visualization," from G E Jones, W E Chalecke, J Dec, J Schilling, H D Robertson, G H Ramsey, and W H Strain, of Rochester, N Y, next "Studies on Emulsions of Ethyl Iodophenylundecylate as Media for the Visualization of Body Cavities," also from the Rochester group—W E Chalecke, G E Jones, M P George, E B Mahoney and W H Strain, and another by John Caffey, "Infantile Cortical Hyperostoses A New Syndrome" Two fine symposia were presented on the last day, one on diseases of the chest, presided over by L Henry Garland, who at the Banquet on Thursday evening had been named the President-Elect of the Society, the other on the roentgen diagnosis and treatment of bursitis and arthritis, under the guidance of Ernst Pohle

This report by no means catalogues all the fine papers that were presented Only the highest of many high spots have been touched There was no essayist who did not offer something well worth listening to These papers, as they appear in RADIOLOGY, are going to make fine reading, so plan to take time in the coming months to study your journal, not just read it

Not only was the scientific content of this meeting unusually high, but great pleasure was enjoyed by everyone in seeing old friends and renewing acquaintances after the lean war years with their restrictions upon such gatherings

SYDNEY J HAWLEY, M D

patic or renal veins Records of blood pressure in the various heart chambers and of oxygen saturation of the samples removed from these chambers were used in identifying cases of congenital heart disease and selecting certain ones for operation

IRVING TREIGER, M D (*Presbyterian Hospital and University of Illinois, Chicago, Ill*) Correlative Study of Cardiac Diseases There were shown in this exhibit a large number of translite films for correlative study of roentgenograms, electrocardiograms, and pathologic specimens in frequently encountered heart conditions, to emphasize the correlative value of various methods of examination in the diagnosis and treatment of cardiovascular disease

V W ARCHER, M D, GEORGE COOPER, JR, M D, AND N ADAIR, M D (*University of Virginia Hospital, University, Va*) Epidemic Lead Poisoning Due to Inhalation This exhibit demonstrated the x-ray findings in representative cases of lead poisoning from inhalation of lead fumes and in conditions to be considered in the differential diagnosis

ROBERT P BARDEN, M D, AND DAVID A COOPER, M D (*Hospital of the University of Pennsylvania, Philadelphia*) Pulmonary Changes in Certain Conditions Due to Vascular Disease Reductions of chest films were accompanied by case histories and a few pathologic descriptions of diseases such as periarteritis nodosa, lupus erythematosus, influenza, acute rheumatic fever, arsenical toxemia, and acute nephritis, showing distinctive roentgen patterns Charts were used to summarize principles Second award was given to this exhibit

SABINA DI RIENZO, M D (*Cordova, Argentina*) Bronchography Dr di Rienzo brought this exhibit from the International Congress in Havana, Cuba, to Chicago by special invitation of Dr Lowell Goin and Dr James T Case It comprised 132 chest films showing normal and abnormal bronchograms demonstrating a wide range of disease

JOHN S BOUSLOG, M D (*Denver, Colorado*) Roentgenological Study of Acute Infections in the Respiratory Tract of

Children Reductions of films of the paranasal sinuses, mastoids and chests of children with acute infections of the respiratory tract illustrated the necessity of examination of all divisions of the respiratory system in these young patients

H E HILLEBOE, M D, AND H F A LONG, (*U S Public Health Service, Washington, D C*) Miniature Film Mass Radiographic Routine Chest X-ray Examination in General Hospitals This exhibit demonstrated graphically the application of miniature film routine chest examinations to general hospitals, as advocated by the Tuberculosis Control Division of the U S Public Health Service

E P MCNAMEE, M D, AND J V PISCHIERI, M D (*Saint Alexis Hospital, Cleveland, Ohio*) Extensive Endothelioma of the Right Pleura Original films of a striking case of endothelioma of the pleura were shown

FRANCIS L SIMONDS, M D, AND CLYDE C HARDY, M D (*Omaha, Neb*) Primary Lung Cancer Reductions of chest films from cases of primary carcinoma of the lung, together with case reports and statistics made up this exhibit Many variations in chest film findings in primary cancer of the lung were shown

ARCHIE SHEINMEL, M D, AND BERNARD ROSWIT, M D (*U S Veterans Hospital, Bronx, N Y*) Primary Cancer of the Lung A second exhibit on lung cancer consisted of material drawn from a ten-year study of 600 cases treated at a Veterans Hospital, from September 1936 to September 1946 All of the cases presented were proved histologically A careful analysis of the pathologic physiology was included and the life pattern of the disease was shown Surgical and radiation results were presented

Four exhibits concerned primarily the alimentary tract

AUBREY O HAMPTON, M D, MILTON FRIEDMAN, M D, IRVING B BRICK, M D, AND ELLERY M JAMES, M D (*Walter Reed General Hospital, Washington, D C*) Radiation Injury and Tolerance Dose of

The Scientific Exhibits

The thirty-two scientific exhibits entered at the meeting of the Radiological Society of North America, in Chicago, may be classified under the headings of Bones, Chest, Gastro-Intestinal Tract, Genito-Urinary System, Therapy, and Miscellaneous

There were six exhibits having to do with the skeletal system

NORMAN HEILBRUN, M D (*Buffalo, N Y*), WM G KUHN, M D (*Boston, Mass*), ARTHUR B SOULE, JR (*Burlington, Vt*), AND SAMUEL L MELTZER (*Portsmouth, Ohio*) Erosive Bone Lesions and Soft Tissue Ossifications Associated with Spinal Cord Injuries (Paraplegia) This exhibit, which received honorable mention, demonstrated calcifications occurring in the soft tissues of paraplegic patients and extensive erosions in the bones associated with decubitus sores of the trochanters

JOHN F HOLT, M D (*University of Michigan, Ann Arbor, Mich*) A Roentgenographic Review of Interesting Skull Lesions Dr Holt showed a collection of skull roentgenograms from the files of the University of Michigan Hospital Some fairly common lesions were shown, and some distinct oddities

RAYMOND W LEWIS, M D (*Hospital for Special Surgery, New York City*) Roentgen Ray Diagnosis of Pigmented Villonodular Synovitis and Synovial Sarcoma of the Knee Joint The pathology of villonodular synovitis was demonstrated in this exhibit Roentgenograms of proved cases and others of synovial sarcoma indistinguishable from villonodular synovitis were shown Three cases of synovial sarcoma which could be differentiated from villonodular synovitis were demonstrated

J E LOFSTROM, M D, J E WEBSTER, M D, AND E S GURDJIAN, M D (*Wayne University, St Mary's Hospital, and Grace Hospital, Detroit, Mich*) Penetrating Cranial Wounds A collection of x-ray reductions demonstrated various types of penetrating wounds of the cranium, to-

gether with the operative treatment in each case A large number of plates illustrating pneumoencephalographic findings at various stages of progress of the cases and colored photographs of the patients were included Third award was given to this exhibit

ROBERT J REEVES, M D, LENNOX BAKER, M D, AND DAVID McCULLOCH, M D (*Duke University, Durham, N C*) Radiation Therapy and Orthopedic Care in Marie-Strumpell Arthritis The orthopedic and radiotherapeutic care of patients with Marie-Strumpell arthritis and follow up results were demonstrated in this exhibit Case reports were presented in the form of appropriately captioned films and photographs

GEORGE M WYATT, M D (*Radiological Clinic of Drs Groover, Christie & Merrill, Washington, D C*) AND W S RANDALL, M D (*Watts Hospital, Durham, N C*) Benign and Malignant Lesions of Bone Radiological and Pathological Correlation This exhibit consisted of lantern slides showing the roentgenological changes seen in various types of benign and malignant lesions of bone and the correlated gross and microscopic pathologic changes

Chest studies were represented by ten exhibits, and to exhibitors in this group went the two first awards

LEWIS F DEXTER, M D, AND MERRILL C SOSMAN, M D (*Peter Bent Brigham Hospital, Boston, Mass*) Venous Catheterization of the Heart Clinical and Experimental Observations This exhibit, which won the first award, was made up of photographs, drawings, and reproductions of films, supplementing papers presented by the authors Along flexible catheter is inserted in the antecubital vein and passed, under fluoroscopic guidance, through the axillary vein to the superior vena cava and into the heart From the right auricle it is guided either into the right ventricle and pulmonary artery or into the inferior vena cava and thence into the he-

scopic and roentgen material, accurate diagrams of anatomical treatment level, and manipulation of isodose curves to determine number of ports and their angulation and separation, thus determining the total dose to the tumor as well as to adjacent structures

EDITH H. QUIMBY, D Sc (*College of Physicians and Surgeons, Columbia University, New York City*) Dr Quimby's exhibit consisted of ten large charts which gave the basis for radium dosage expression in roentgens, Paterson and Parker charts for linear, area, and volume dosage with examples, Quimby tables for external, linear, and volume dosage, with examples

E. D. TROUT AND Z. J. ATLEE (*General Electric X-ray Corporation, Chicago, Ill.*) Low Absorption Roentgen-Ray Measurements from 500 to 1000 Kilovolts This exhibit was made up of panels on which were mounted a series of experimental x-ray tubes and illuminators for display of transparent prints of absorption data

The remaining exhibits may be grouped as Miscellaneous

M. M. ZINNINGER, M D, AND C. M. BARRETT, M D (*University of Cincinnati, Ohio*) A Pathological Study of Total Organs Large microscopic sections of removed tissue were shown with corresponding roentgenograms of many lesions The group included total microscopic sections of stomach, bowel, breast, uterus, lung, testes, bladder, and kidney

SAMUEL BROWN, M D, AND ARCHIE FINE, M D (*Jewish Hospital, Cincinnati, Ohio*) The Diaphragm—A Radiologic Study in Three Dimensions Roentgenograms of the diaphragm in the anterior and lateral projections were displayed, showing the exact position, shape, and contour of the entire structure under normal and abnormal conditions The various effects

upon the position and shape of the diaphragm of an enlarged liver, spleen, kidneys, and subphrenic abscess were shown, and criteria for their differentiation, also, cases showing lesions above and below the diaphragm and their differentiation, and cases of hernia, their localization with and without barium and their effect upon thoracic and abdominal organs

A. O. HAMPTON, M D (*Veterans Administration, Washington, D C*) Opportunities for Radiologists in the Veterans Administration Architect's sketches of proposed new Veterans Hospitals and a typical lay-out for a thousand-bed hospital were presented A large placard indicated opportunities for radiologists in the Veterans Administration

PAUL S. HENSHAW, PH D (*Monsanto Chemical Company, Clinton Laboratories, Knoxville, Tenn.*) AND PAUL C. AEBERSOLD, PH D (*Isotopes Branch, Research Division, Manhattan District, Oak Ridge, Tenn.*) This exhibit, presented by invitation, consisted of photographs of laboratory animals which had received fairly large doses of radioactive material over a long period of time and had developed abnormal growths, some of which were malignant in character The source of radiation was P³²

JAMES J. NICKSON, M D, AND MARGARET J. NICKSON, M D (*Argonne National Laboratory, Chicago, Ill.*) A Study of Epithelial Reduction and Skin Capillaries After Radiation Color film showed blood capillaries and skin damage from radiation Black and white photographs of these changes, together with wax impressions, were also exhibited A camera for photographing the capillary changes and one for photographing the hands, together with equipment for making finger ridge impressions, were used for studying the hands of the visiting radiologists

CLARENCE E. HUFFORD, M D

The Commercial Exhibit

The Commercial Exhibit section of the Thirty-Second Annual Meeting of the Radiological Society of North America oc-

cupied sixty-eight booth spaces in the exhibit room of the Palmer House, immediately adjacent to the Scientific Exhibit

Normal Stomach Unique lesions of the stomach, many with ulceration, were demonstrated radiographically in cases of carcinoma of the testis in which retroperitoneal lymph nodes were treated with supervoltage x-rays. Kodachrome photographs and photomicrographs of these cases were shown, as well as the roentgenograms. Information as to tolerance doses was presented.

FRED MONAGHAN, M D, AND ARTHUR FINKELSTEIN, M D (*Graduate Hospital, University of Pennsylvania, Philadelphia*) **Complementary Value of Gastroscopy and X-ray Examination** This exhibit demonstrated examples of cases studied by x-ray and by gastroscopy, showing instances in which one or the other or both methods were in error. A classification of the causes of such errors was given. Radiographs, reproductions in color of the gastroscopic pictures, and photographs of specimens were shown.

W R SCOTT, M D, AND G W JAEGER, M D (*The Niagara Falls Memorial Hospital, Niagara Falls, N Y*) **Pre-Natal Gallstones** By means of original radiographs and photographs of postmortem specimens, these exhibitors presented the case of an infant born with a gallbladder full of calculi, which ruptured at or shortly after birth.

HARRY M WEBER, M D, AND C A GOOD, JR, M D (*Mayo Clinic, Rochester, Minn*) **Roentgenologic Diagnosis of Meckel's Diverticulum** Reproductions of roentgenograms, charts, and line drawings illustrated the manner in which Meckel's diverticulum is exhibited radiologically.

There was a single exhibit dealing with the male genito-urinary tract and two in the field of gynecology and obstetrics.

MILTON FRIEDMAN, M D, AND LLOYD G LEWIS, M D (*New York University, New York City*) **Testis Tumors** By charts, x-ray films, color photographs, and colored photomicrographs, the exhibitors presented an analysis of 250 cases of carcinoma of the testis seen at Walter Reed General Hospital over a period of four

years, covering histogenesis, pathological classification, lymph node distribution, therapeutic management, special methods of depth dose determination, radiation injuries and tolerance doses of normal thoracic and abdominal organs, time intensity dose studies, prognosis, arrest of advanced disease especially in radioresistant cases, effect of radiation on retroperitoneal nodes, spontaneous disappearance of metastatic lesions, hormone bio-assay, and atypical metastases.

E P MCNAMEE, M D, AND J V PISCHIERI, M D (*Saint Alexis Hospital, Cleveland, Ohio*) **Extra-Uterine Intra Abdominal Pregnancy** This exhibit demonstrated with roentgenograms and photographs an unusual case of extra uterine intra-abdominal pregnancy.

EDWIN C ERNST, M D (*Barnard Free Skin and Cancer Hospital, St Louis, Mo*) **Carcinoma of the Cervix—New Expanding Type of Double Cross-Arm Intravaginal Radium Applicator** Photographs and models were shown of a new expanding type of double cross-arm intravaginal radium applicator, and the use of lucite tubing for intravaginal radiation therapy was demonstrated.

In addition to papers in the classifications given above, there were a number dealing with general therapeutic problems.

WILLIAM E HOWES, M D (*Brooklyn Cancer Institute, Brooklyn, N Y*) **"Tumor Dose"—Method of Calculation and Charting as Carried Out at Brooklyn Cancer Institute** This exhibit consisted of charts and explanatory material, mounted in order to demonstrate the calculation of tumor dose from the initial stages to the point of charting, as carried out at the Brooklyn Cancer Institute.

LOUIS C KRESS, M D, AND WALTER T MURPHY, M D (*Roswell Park Memorial Institute, Buffalo, N Y*) **Cross-Fire X-ray Technic** The steps necessary in determining proper treatment factors in multiple port x-ray therapy were demonstrated, including physical examination of the patient, review of pathological, endo-

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ground were also a Du Pont product.

*Eastman Kodak Company (Rochester 4,
N Y)* Features of the exhibit presented
by the Medical Division of the Eastman
Kodak Co were the demonstration of
"Blue Brand X-ray Film from the in-
side out" and "Ektachrome the new
Kodak full-color sheet film that you pro-
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ous use of white and ultraviolet light, simu-
lated Blue Brand Film in cross section, at
high magnification, during exposure to the
fluorescent light of intensifying screens and
after processing. The Ektachrome display
consisted of medical photographs made
with the latest addition to the Kodak
family of color products. Other sections
showed the new white interleaving paper
for Kodak x-ray films, the new single-
powder Kodak x-ray fixer, radiographs
made with Blue Brand and No-Screen
x-ray films, full-color photographs made
with Kodachrome film.

*Eureka X-ray Tube Corporation (Chicago,
Ill)* In spite of the lack of lighting facili-
ties due to the "brown-out," the Eureka
Co had an excellent exhibit. Of interest
to all is the fact that this company will
start full production of rotating anode
tubes (after completing two years of field
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The company exhibited, for the first
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and table, whose salient feature is a beryl-
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Rating is from 30 to 100 kv. Demon-
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The Thos B Gibbs Division of the George
W Borg Corporation was a new exhibitor.
Their space attractively demonstrated
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Thirty-two concerns were in attendance. This exhibit was the largest in the history of the Society, and formed an interesting and valuable part of the meeting. The courtesy and co-operation shown by all the exhibitors, especially when the lack of proper lighting facilities due to the "brown-out" was considered, was almost more than could be hoped for. When, toward the end of the meeting, it appeared that it might become necessary to dismantle the exhibits in order to move the equipment before the impending freight embargo became effective, all the exhibitors voted to stay until the close of the meeting rather than break up the exhibit. This show of confidence as to the value of the Commercial Exhibit justified the many hours of work on the part of the Commercial Exhibits Committee and the hotel management.

Nearly all the exhibitors have indicated their desire to participate in the meeting next year and several are planning more extensive displays. The committee has on file the names of several firms who were unable to exhibit this year, but who plan to show with us in the future. We therefore expect an even bigger and better exhibit in 1947. As a place to show goods to a select and interested group, and to make new acquaintances and renew old friendships, it would be difficult to find a better location than the commercial exhibit section at the annual meeting of the Radiological Society.

It would take more space than is available to do justice to the individual exhibits. In order, however, to give those who were unable to attend this meeting a little idea of what was to be seen, brief descriptions follow.

AnSCO (Binghamton, N Y) The AnSCO exhibit featured radiographs made on both regular and non-screen types of x-ray film, AnSCO color transparencies and printons of medical and general photographic subjects. In addition, a complete line of AnSCO cameras and photographic materials was on display. The new AnSCO reflex camera, which will be placed on the market within the near future, attracted considerable interest.

Buck X-Ograph Co (St Louis, Mo) The Buck X-Ograph Co demonstrated its well known line of film processing tanks and accessories. The automatic control of solution temperatures by thermostatic regulation as shown in the Buck set up interested many visitors. A film pass with interlocking doors and the Buck film dryers attracted much attention.

Canadian Radium & Uranium Corporation (New York 20, N Y) Interesting features of the Canadian Radium and Uranium Corporation's display were the new gold-plated monel plaques of half and full-strength type, the monel nasopharyngeal applicator for the irradiation treatment of hyperplastic lymphoid tissue, made in accordance with the technic of Crowe and Burnam, and radon ointment, the new form of radiation therapy with the alpha rays of radon.

The Coca Cola Co (Wilmington, Del) The gaily decorated Coca-Cola refreshment stand acted as a magnet to practically everyone attending the meeting. In fact, many must have accepted its hospitality several times as, believe it or not, approximately 5100 free bottles of this refreshing beverage were served.

F A Davis Co (Philadelphia 3, Penna) The medical publishers, F A Davis Co, featured the new two-volume "Clinical Radiology," edited by George V. Pillemer. Fifty-nine American authorities have contributed to make this work an outstanding achievement of medical publishing. A review of the book has already appeared in *RADIOLOGY* (47: 413, 1946).

Jno V Doehren Co (Chicago, Ill) The film and print processing Jaco automatic device, designed by Dr. A. R. Hansen, was for the first time presented. It provides temperature control of solutions by running hot, cold, and ice water mixed by a blender and controlled by a thermometer, an easily regulated timer for the developing tank, and quick automatic elevation of films to successive tanks, reducing oxidation. The machine will take a film every 30 to 60 seconds. It is simply operated, automatically or by hand.

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Lea & Febiger, Publishers (Philadelphia 6, Penna.) Lea & Febiger exhibited the new fourth edition of MacKee and Cipollaro's classic, "X-Rays and Radium in Treatment of Diseases of the Skin," as well as new editions of Davidoff and Dyke's "The Normal Encephalogram" and Wesson's "Urologic Roentgenology." Forthcoming new editions of Pohle's "Clinical Roentgen Therapy" and Holmes and Robbins' "Roentgen Interpretation" were announced. Among general medical reference works, Gray's "Anatomy" and Boyd's "Pathology of Internal Diseases" continued to command interest.

The Liebel-Flarsheim Co (Cincinnati 2, Ohio) The Liebel-Flarsheim Co exhibited representative items from their line of precision-built x-ray specialty devices. X-ray timers and stationary filter grids for secondary radiation were featured. As a museum piece, they had on exhibition one of their earliest timers, which still operates with absolute accuracy, in spite of years of hard usage.

Machlett Laboratories (Springdale, Conn.) The complete line of Machlett x-ray tubes was exhibited. A new tube with external beryllium window, for operation at 5 to 50 kv, a new shock-proof 100-kv tube for under-table fluoroscopy and spot-film radiography, and the two-million-volt precision x-ray tube for use with the Van de Graaff electrostatic generator were high lights of the exhibit.

F Mattern Mfg Co (Chicago 30, Ill.) Displayed at the Mattern booths were the Mattern 200-ma two-tube unit with rotating anode tube, spot radiographic device, and automatic control, also the increasingly popular Mattern 70-mm portable chest unit. The popular MX-100-ma single-tube motor-driven table unit with automatic deluxe push-button control received its full share of attention.

The Medical Bureau (Chicago, Ill.) Miss M. Burneice Larson's Medical Bureau was capably represented, reminding radiologists of its facilities as a counselor in the problems of medical personnel. It has available the records of diplomates of the

American Boards, younger physicians interested in obtaining training and, also, of administrators, executive and supervising nurses, scientists, laboratory technicians, x-ray technicians, social workers and dietitians for those interested in the completion or re-organization of their staffs.

The Wm Meyer Co (Chicago 2, Ill.) The Wm Meyer Co, manufacturers of electrical equipment for professional use, presented the Meyer "Head and Specialist Unit," for the production of negatives of the head with the patient seated in a comfortable upright position. Stereoscopic facilities are included, and the rotating parts are fully calibrated for repeating positions. A choice of generators is available for use with this unit.

North American Philips Co (New York 17, N Y) North American Philips Co exhibited a clever arrangement for miniature radiography which will adequately accommodate either ambulant or stretcher cases. In addition, a contact and cavity therapy apparatus was demonstrated. This compact unit is designed for contact therapy on the skin or in surgically exposed lesions which require treatments of short duration and high intensity. A newly designed diagnostic x-ray unit (200-ma) was also displayed. Its many features were spot-lighted by a new spot-filming device which is simple in construction and positive in operation.

Pickering X-Ray Corporation (New York 10, N Y) The Pickering X-ray Corporation displayed a number of the units which are available in their "Minograph Line-up" of chest x-ray screening apparatus. This equipment is designed to provide thirty-six different combinations for the use of roentgenologists in consultative group screening and diagnosis and of hospitals in admission and out-patient screening. It includes equipment for large and small group chest surveys and mobile clinics.

Any of the various units in the "Minograph" line may be fitted with either automatic 70-mm roll-film camera, automatic 70-mm cut film four shot camera, automatic 4 × 5" cut-film four shot camera,

or manual 35-mm roll-film camera. The "Thoragraph" unit for photo-timed 14 X 17" chest radiographs was also displayed.

Professional Equipment Co (Chicago 7, Ill) The Professional Equipment Co, manufacturers of the Profexray, displayed three units—a portable, a mobile, and a combination radiographic and fluoroscopic unit. Particular interest was demonstrated in their light-weight 80-kv and 20-ma portable model, which may be used as a portable unit in the patient's home or as an auxiliary to heavier equipment.

Radiology (Detroit 2, Mich) A "blown-up" cover and contents page of the most recent issue of RADIOLOGY, with some enlarged illustrations grouped around the seal of the Radiological Society, served to remind members and others that this is the official organ of the Radiological Society of North America. Copies of RADIOLOGY, a booklet of "Instructions to Authors," reprints of a symposium on Protection recently published, and other items were to be had for the asking. Copies of the Cumulative Index were also on display.

Radium Chemical Co, Inc (New York 22, N Y) Radium Chemical Company, Inc, displayed its new type, monel metal nasopharyngeal applicator, used in the prevention and treatment of deafness caused by hyperplastic lymphoid tissue. Non-removable all-gold radon implants, the newest types of radium containers, and a complete line of radium and radon accessories were shown.

Rexair, Inc (Detroit 2, Mich) These exhibitors describe their product as a "portable air cleaner" that performs many hospital jobs. It purifies, deodorizes, and humidifies the air, cleans floors, walls and furniture, scrubs floors, draws in dust-laden air and sends out clean, moist air.

J B Roerig & Co (Chicago 11, Ill) The representatives of this company, exhibiting for the first time at a Radiological Society meeting, expressed themselves as surprised and pleased at the interest shown in their products. "Heptuna" for the secondary anemia frequently seen following radiation therapy and for radiation

sickness and "Darthronol" which is being used supportively in the arthritides.

Schering Corporation (Bloomfield, N J) The Schering exhibit featured, among other drugs, the well known contrast media, Priodax and Neo-Iopax. Dual panels showed x-ray films demonstrating the clearly visualized gallbladder after the administration of Priodax and the uniformly good portrayal of the kidney pelvis, ureters, and bladder obtained with Neo-Iopax intravenously. Also included in the exhibit were the estrogenic preparations Estinyl and Oreton, and Cortate, a desoxycorticosterone recommended for adrenal deficiency states.

Standard X-Ray Co (Chicago 14, Ill) The Standard X-Ray Co exhibited both diagnostic and deep-therapy apparatus. The Console Therapy Control shown with a light enamel finish invited much attention not only because of its attractive appearance but also because of the practical arrangement of the operating and measuring instruments incorporated in the control panel. Many favorable comments were also made about the 220-kilovolt Flexray Therapy Tube Stand and the new Standard 70-mm miniature film apparatus, so designed that it is practical as a transportable unit or for permanent hospital installation.

The Model F combination radiographic and fluoroscopic motor-driven table was also exhibited, as was the Model MO 500-ma Master Control Panel, incorporating safety features which make it possible to operate as easily and as safely at 500-ma loads as it is to make exposures at 5-ma.

The Victoreen Instrument Co (Cleveland 14, Ohio) The Victoreen Instrument Co exhibit offered complete coverage, with instruments for measuring dosage and for protection from scattered radiation. Of especial interest was the "Proteximeter," which is designed to measure minute quantities of x-radiation, calibrated directly in milliroentgens with full scale 200 milliroentgens or 0.2 r. Any radiation present is indicated accumulatively.

Westinghouse Electric Corporation (Pittsburgh 30, Penna) As an example of their

planning service, the Westinghouse Corporation displayed a scale model of the diagnostic wing of a new 1,000-bed Veterans Hospital. Other features of the exhibit were the new motor-driven "Duoflex" x-ray table with four-way spot-film device and the wall-mounted 150-kv intermediate therapy equipment with associated 150-kv control mounted on an "Airline" technician's desk. Installed in the back wall of the booth were 150-kv and 250-kv therapy controls. Both these, as used with the constant potential transformer unit, had hinged front panels affording easy access to the wiring assembly. Also displayed were 200-ma semi-automatic and 500-ma full automatic controls.

Winthrop Chemical Co., Inc. (New York 13, N. Y.) Winthrop Chemical Co., Inc., featured the widely used radiopaque agents—Diodrast, Diodrast Compound, Skiodan. A newly introduced Diodrast Solution for cardioangiography was promoted for the first time.

The Year Book Publishers, Inc. (Chicago 4, Ill.) The Year Book Publishers exhibited a full line of medical books featuring "Radiology for Medical Students" by Hodges, Holt and Lampe and the 1946 "Year Book of Radiology" edited by Waters and Kaplan. The Roentgen Diag-

nosis Handbooks, including "The Chest" by Rigler, "Osseous System" by Archer, "Gastro-Intestinal Tract" by Hodges, "Urinary Tract" by Kerr, "Arthropathies" by de Lorimier, and Caffey's "Pediatric X-Ray Diagnosis" were displayed. Also offered were Kaplan and Rubenfeld's "Topographic Atlas for X-Ray Therapy," Hilleboe and Morgan's "Mass Radiography of the Chest", and Glasser's "Medical Physics."

York Microstat of Illinois, Inc. (Chicago, Ill.) This organization, using new type equipment and processing technics, invented by W. U. Zeller, Technical Director, produces controlled density recordings of x-ray films. These miniature reproductions on 35-mm and 70-mm microfilm are notable for their high fidelity of detail and density values, giving a reproduction apparently identical with the original. The two principal uses of interest to radiologists are (1) long-term retention of x-ray files, with great reduction of storage space and improved reference convenience, (2) as a better medium for visual instruction. An example of a teaching application was demonstrated by the 35-mm film strip which recorded a portion of the skull section of the University of Michigan's film library.

W. R. SCOTT, M.D.

The Refresher Courses

Registrations for the Refresher Courses held in connection with the 1946 meeting of the Radiological Society of North America totalled 679, from 41 states, Illinois leading with 123, followed by New York with 82 and California with 49. Canada, Cuba, Honolulu, Central America, Argentina, and Chile were also represented. The total included members, non-members, residents, and students, with the three latter groups outnumbering the members. There was excellent attendance at all courses, even on the last day of the meeting, when many had already left for home. The approximate total for the thirty courses was 4,550.

Nearly 600 attended the film-reading

session, which was ably handled by Drs. Sosman, Camp, and Garland. They were somewhat handicapped, inasmuch as no projectoscope could be obtained, bringing to our attention the necessity of making some changes in the procedure at future sessions. One hitherto unannounced "fact," that lues is rare in California, we are quite sure will interest the Chambers of Commerce of that state. This remark ended this session and added to the humorous ribbing between Boston, Rochester, and San Francisco.

The courses in Gastro-Intestinal Diseases and associated conditions, Sunday through Friday, drew the largest total attendance. These courses were given by Drs. Samuel

Brown, Byrl R Kirklin, Fay H Squire, James B Eyerly, H C Breuhaus, G M Hass, John M Dorsey, E H Fell, Ross Golden, David G Pugh, and Leo Rigler

We wanted to give more time to Chest Diseases, but a limited number of rooms and time prevented, so that we had to be content with only four periods, which we thought should be of special interest Dr L R Sante discussed the Pneumonias in his usual excellent style Dr Laurence L Robbins received especially favorable comment for his presentation of Segmental Collapse of the Lungs Dr L W Paul likewise presented a meticulous course on the Clinical and Roentgenologic Aspects of Bronchography, which was greatly enjoyed Drs Russell H Morgan and David M Gould gave a course on Miniature Chest Films to a small but very interested audience, evoking prolonged discussion

The three sessions on Bone Pathology, the first given by Drs John D Camp and David G Pugh on Generalized Bone Disease, and the others by Dr L Henry Garland on Differential Diagnosis between Arthritis and Attrition, were enthusiastically received by overflow crowds

Drs Robert P Barden, George W Chamberlin, and P Boland Hughes presented the sections on Roentgenology of the Urinary Tract There is a demand every year for this course, and the speakers did their usual thorough and interesting job

The therapy sessions included as many of the various systems and types of therapy as possible, beginning on Sunday with Dr Walter Wasson's version of Intravaginal Irradiation This was followed by a discussion of the Use of Radioactive Isotopes by Drs B V A Low-Beer and Edward H Reinhard These two courses were apparently of special interest both to the Radiation Therapists and the Physicists and served to clarify many points previously not understood

Our old standbys, Edith H Qumby and J L Weatherwax, helped out with their presentations of Practical Problems in Radium Dosage and X-Ray Measurements

Dr Bernard P Widmann presented a course on Cancer of the Skin, Dr A N Arneson, on Carcinoma of the Female Genital Tract, including a movie of his method of transvaginal irradiation, Dr Herbert Schmutz discussed When, How and Why Should Carcinoma of the Breast Be Treated, Dr Milton Friedman, Carcinoma of the Male Genital Tract, Dr James A Corscaden, Treatment of the Benign Lesions of the Female Genital Tract, and Dr Juan A del Regato gave a two-session course on the Classification, Diagnosis, and Evaluation of the Different Forms of Treatment of Cancer of the Oral Cavity, Pharynx, and Larynx The diagnosis and treatment of Diseases of the Brain and Spinal Cord were presented by Drs T J Wachowski, A J Peterson, Eric Oldberg, Percival Bailey, Paul C Bucy, and Roger T Harvey All of the therapy courses were well attended, and all of those interviewed expressed themselves as very pleased that they had been present

We were particularly interested in the opinion of the men from the Army and Navy recently returned from service, that all of the courses had been most helpful in renewing their acquaintance with civilian radiology From the requests and comments, it seems that the Refresher Courses are one of the most popular parts of the meeting, and we hope that we can give many more, equally interesting, for the benefit of the members of the Society and others interested in radiology It is our impression that these courses occupy a very definite place, doing just what the name implies—refreshing and renewing our knowledge of our specialty

The Refresher Course Committee wishes to acknowledge the excellent help given by the committee, composed of Drs T J Wachowski, E E Barth, B D Braun, J H Gilmore, B M Johnson, and A J Peterson, and we would be more than remiss if we did not say an added thank you to Dr Warren Furey

KENNETH DAVIS, M D

PAUL C SWENSON, M D

C EDGAR VIRDEN, M D, *Chairman*

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very attractive, manned by a large personnel of Spanish-speaking exhibitors, who made the most of the opportunity of meeting so many representatives of radiology from the various countries of the new world

The social program deserves special mention and an expression of gratitude for the untiring efforts of the local committee of radiologists and their ladies. The program included luncheons for the visitors, a visit to the National Medical College, which corresponds to our American Medical Association, a cocktail party offered to the delegates and their wives by the House of Bacardi, a final banquet at the Vedado-Tennis Club, with typical and interesting entertainment, followed by the grand ball. Finally, on Friday afternoon, there was a luncheon and beach party at the Sevilla-Biltmore Yacht and Country Club, and on Saturday, after the close of the Congress, a country picnic at the Rio Cristal, with a luncheon of various typical Cuban dishes, with delightful entertainment, including a demonstration of the rhumba. During the week a brilliant fashion show was put on for the ladies, as well as sight-seeing tours of Havana. Numerous private entertainments and parties also took place. The delegates will remember with gratitude the hospitality of their charming hosts.

The adjunct-secretaries, Dr Eduardo Rivero and Dr Rafael A. Gómez, the Committee Chairmen, Drs Padrón, González Peña, Raúl Pereiras, Elizondo Martell, and their various committee members all share in our thanks for their efficient work.

Of the eighty-four papers listed in the official program, seventeen were solicited from and contributed by United States delegates. Six papers were contributed by Canada. The remainder were distributed among the other countries represented. There were four principal topics for discussion, to each of which an afternoon session was devoted. (1) *Carcinoma of the Stomach*, which was discussed by Dr Burlando of Argentina, Dr Caminha of Brazil, Dr Daza and his colleagues from Chile, Dr Rigler from the United States, Dr Oscar

Soto from Peru, and Dr Codas Thompson of Paraguay.

(2) *Bone tumors* were discussed by Dr Maissa of Argentina, Dr Guzman and his associates from Chile, Drs LeMone and Ackerman from the United States, and Drs Frangella and Rivas of Uruguay.

(3) *Bronchiogenic carcinoma* was reported upon by Drs Molinari and Malenchini from Argentina, Drs Casarino and Mella from Chile, and Dr Schmidt from the United States.

(4) *Radiological mass investigations* were discussed in a paper sent in by Dr Morgan and Dr Hilleboe from the United States, by Dr Gundelach and his colleagues from Chile, and finally by Dr Carlos Gómez del Campo from Mexico.

All of these papers will appear in the radiological journals of their respective countries, and it is planned to publish the lot of them in a single volume in the language in which they were given.

Some outstanding papers from our Latin-American colleagues included one on "Infectious Spondylitis," by Dr S. di Rienzo from Argentina, with numerous beautiful illustrations, including some cases of brucellosis. Dr G. Esguerra Gómez of Colombia gave an interesting paper on the "Osseous and Articular Lesions of Leprosy," based on a study of 500 cases of this disease in both sexes at various ages. In addition to the papers given in the *ponencias* or discussions on special topics, there were other various excellent contributions on tumors of the stomach, including those by González Peña and Hernández Beguerie of Havana, Sobá of Santo Domingo, Golden and Stout of the United States, and Daza of Chile.

Considerable attention was paid to the roentgen diagnosis of breast lesions, both in males and females. On this subject there was an extensive exhibit by Dr Felix Leborgne and his colleagues from Montevideo. Another interesting exhibit was that of Dr Aguirre and his Cuban associates on mastography.

The study of the respiratory passages by contrast media was presented in the pro-

The Second Inter-American Congress of Radiology

Havana, Cuba, Nov 17-22, 1946

At the combined meeting of the Radiological Society of North America and the American Roentgen Ray Society held in the fall of 1944, Dr W Edward Chamberlain, Dr Pedro L Farinas, and the writer were named as a committee to represent the Radiological Society of North America in cooperating with the Cuban Society of Radiology in arranging for the Second Inter-American Congress of Radiology. Committees were also named by the American Roentgen Ray Society and American College of Radiology. Because of the overlapping personnel of these committees, they were joined into one general committee for the United States, with the writer as Chairman and Mr Mac F Cahal as Secretary.

The First Inter-American Congress of Radiology held in Buenos Aires in 1943, under the Presidency of Dr José F Merlo Gómez, had chosen Havana as the site of the Second Inter-American Congress of Radiology, and this automatically made the Cuban Society of Radiology the Committee of Arrangements. The Cuban society, under the Presidency of Dr Pedro L Farinas, included Dr R Hernández Beguerie as Secretary-General, Dr Ernesto Fonts as Treasurer, and Dr Armando Cabrera and Dr C Rodríguez Remus as vocales.

The Society elected Dr Pedro L Farinas as President of the Second Inter-American Congress. Honorary Presidents included the Honorable President of the Republic of Cuba, Dr Grau San Martín, the Minister of Health and Social Assistance, the Rector of the National University, the Dean of the School of Medicine, and the President of the First Inter-American Congress of Radiology, Dr José F Merlo Gómez. Honorary members included the presidents of the societies of radiology of the American continents, the presidents of the medical societies of Cuba, and the Professor of Radiology and Physiotherapy at the Na-

tional University of Havana, Dr Manuel Viamonte.

The opening meeting was a picturesque and festive affair, which will be long remembered by all who were present. The Congress was inaugurated by the President of the Cuban Republic, Dr Grau, in the presence of the diplomatic corps and the delegates to the Congress. Dr J F Merlo Gómez, President of the First Inter-American Congress of Radiology, inducted the new President, Dr Pedro L Farinas, of Havana. Both of these physicians spoke at some length on the international character of the science of radiology and the great satisfaction felt by all at the numerous representations from all of the American countries. More than 650 delegates and members of their families were registered at the meeting. Some of the official delegates of the various countries were introduced, and the writer was then called upon for an address on "Radiology in America." In elaborating upon this subject he chose to pass over the evolution of radiology in the United States and Canada, referring to the numerous publications on the subject in "The Science of Radiology" and in the 1946 anniversary numbers of *RADIOLOGY* and *The American Journal of Roentgenology and Radium Therapy*, and to the full record of the fifty years of radiological development, as shown in the volumes of *RADIOLOGY* and of *The American Journal of Roentgenology and Radium Therapy*. He then described in some detail the origins and developments of radiology in the principal Latin American countries. His address will be published in full at a later date.

In the following days, Monday to Friday inclusive, the program was carried out with the presentation of eighty-three formal papers and a large and extremely rich collection of radiographic exhibits, comprising the scientific exhibition. The commercial exhibit was a large one, well organized and

ANNOUNCEMENTS AND BOOK REVIEWS

RADIOLOGICAL SOCIETY OF NORTH AMERICA

The newly elected officers of the Radiological Society of North America are President, Frederick W. O'Brien, M.D., Boston, President-Elect, L. Henry Garland, M.D., San Francisco, 1st Vice-President, Ira H. Lockwood, M.D., Kansas City, Mo., 2d Vice-President, Harold W. Jacox, M.D., Pittsburgh, 3d Vice-President, Robert C. Pendergrass, M.D., Americus, Ga., Secretary-Treasurer, Donald S. Childs, M.D., Syracuse, N.Y., Librarian, Howard P. Doub, M.D., Detroit, Member of the Board of Directors, Joseph C. Bell, M.D., Louisville, Ky.

CLINICAL CONFERENCE OF MIDWESTERN RADIOLOGISTS

The Seventh Annual Clinical Conference of Midwestern Radiologists will be held in Cleveland, at the Statler Hotel, on Friday and Saturday, Feb. 14 and 15, 1947. An excellent program has been arranged, with emphasis on the clinical aspects of radiology. Announcements will be mailed to Midwestern radiologists in the early part of January.

NEBRASKA RADIOLOGICAL SOCIETY

At the Annual Meeting of the Nebraska Radiological Society held in Omaha, in October, the following officers were elected: Dr. D. A. Dowell, Omaha, President; Dr. O. A. Neely, Lincoln, Secretary-Treasurer.

OKLAHOMA STATE RADIOLOGICAL SOCIETY

The Oklahoma State Radiological Society was organized on Oct. 28, 1946, and the following officers were elected: Dr. J. E. Heatley, Oklahoma City, President; Dr. W. E. Brown, Tulsa, Vice President; Dr. P. E. Russo, Oklahoma City, Secretary-Treasurer. The Society plans to hold three regular meetings each year.

TRAINING PROGRAMS IN RADIOLOGY

New York Hospital—Memorial Hospital

The Department of Radiology of New York Hospital is announcing a revision in its training program, increasing the total period of training to four years, with the requirement of one year's previous internship. The first year will be served as junior assistant resident at New York Hospital, the first six months of the second year as assistant resident and the second six months as resident at New York Hospital, the third year as resident at Memorial Hospital, six months being spent in x-ray diagnosis and six months in x-ray and radium therapy, the fourth year as assistant radiologist at New York Hospital (a New York State license will be required).

The equivalent of six months' training in pathology will be given: four months at New York Hospital and two months at Memorial Hospital. One applicant will be accepted each six months, on Jan. 1 and July 1. The next opening is Jan. 1, 1948.

The Department of Radiology at Memorial Hospital is offering one-year fellowships in radiology to those who have completed their requirements for the American Board of Radiology and desire an additional period of training and study in tumor diagnosis and treatment. One candidate will be accepted every six months, usually on April 1 and Oct. 1. The next opening is Oct. 1, 1947.

Candidates interested in the combined resident's position should communicate with Harold L. Temple, M.D., Radiologist, New York Hospital. Those interested in fellowship appointments should communicate with Robert S. Sherman, M.D., at Memorial Hospital.

UROLOGY AWARD

The American Urological Association offers an award, not to exceed \$500, for an essay (or essays) on the result of some clinical or laboratory research in Urology. Competition is limited to urologists who have been in such specific practice for not more than five years and to residents in urology in recognized hospitals.

Full particulars may be obtained from the Secretary, Dr. Thomas D. Moore, 899 Madison Ave., Memphis, Tenn. Essays must be in his hands before May 1, 1947.

Books Received

DIAGNOSTIC ELECTROCARDIOGRAPHIE By ANDRÉ JOUVE, Médecin des Hôpitaux, and JACQUES SENBZ and JEAN PIERRON, Chefs de Clinique à la Faculté de Médecine de Marseille. Préface by Professeur CH. LAUBRY. A volume of 364 pages, with 217 figures and graphs. Published by Masson & Cie, Editeurs, Paris, 1946.

A MANUAL OF TOMOGRAPHY By M. WEINBRENN, B.Sc. (S.A.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.F.R. (Lond.), D.M.R.E. (Camb.), Lt. Col. S.A.M.C., Adviser in Radiology, Union Defence Force, Radiologist, Chamber of Mines Hospital, Johannesburg, Late Radiologist, Queen Mary's Hospital (Roehampton), Ministry of Pensions, Assistant Radiologist, The Middlesex Hospital (London). A volume of 270 pages, with 135 figures comprising 397 illustrations. Published by H. K. Lewis & Co. Ltd., London, 1946. Price 45 s. net.

DIAGNOSIS AND TREATMENT OF MENSTRUAL DISORDERS AND STERILITY By CHARLES MAZER, M.D., F.A.C.S., Assistant Professor of Gynecology.

gram and in exhibits by di Rienzo of Argentina, Aguirre and his colleagues from Cuba, Eduardo Ribero and Veulens of Cuba. Of special interest was an exhibit on anterior pneumomediastinum and on angiocardiology by our Cuban colleagues, and one on retrograde cavography and aortography by Pereiras and Castellanos.

The sessions on irradiation therapy were extremely interesting, and aroused much comment. It had been the intention of the officers of the Congress to hold simultaneous sessions on diagnosis and therapy, but unavoidable restrictions placed by the hotel upon rooms available for the meetings prevented simultaneous section meetings and made it necessary to have a very long, full program which precluded discussions.

The second evening meeting was a solemn session in commemoration of Roentgen. The principal speakers were Dr Edith Quimby of New York, who discussed the basic facts relative to atomic energy in an admirable combination of clear, slow diction, lucid presentation, and graphic illustrations which made her address understandable even by the majority of the Latin-Americans present. Dr G. Esguerra Gómez of Colombia gave a splendid oration on Roentgen, in which he made a special plea for the conservation of the terms "roentgen diagnosis," "roentgen therapy," and "curie therapy," that the names of Roentgen and Curie may not be forgotten. Dr Leonard Guzman also gave an oration on Roentgen.

Just before this evening meeting, the American College of Radiology in an impressive ceremony, which was very much in place in the "solemn session," bestowed honorary fellowships upon Drs Fariñas and Viamonte of Havana, Dr Felix Le-

borgne of Montevideo, and Dr J. F. Merlo Gómez of Argentina, and (*in absentia*) upon Dr Manuel de Abreu of Rio de Janeiro.

At the closing session it was voted to establish an Inter-American College of Radiology, with headquarters in Buenos Aires, where there will be located a permanent secretary. It is the present plan that the officers of the College shall be the officers of the Inter-American Congresses of Radiology, and that the College will be responsible for the conduct of the Inter-American Congresses.

It was voted to hold the next meeting in 1949 in Santiago, Chile. If for any reason the meeting cannot be held in Santiago at that time, Montevideo was named as the alternate location.

There were some defects in the Congress from the standpoint of the English-speaking delegation, especially as to language. It would seem entirely feasible to have less voluminous papers read—papers only so long as could be presented in full at a deliberate rate of reading within the time allotted, and with simultaneous presentation of the English translation on the screen, *vice versa*, it would seem necessary that the English contributions should be presented simultaneously on the screen in Spanish at the moment of reading in the original language. Probably nothing will add to the value of the Congresses so much as this simple measure—to have a bilingual presentation, one by voice and one on the screen.

Perhaps it would not be too early to begin planning for attendance at the Santiago meeting and to arrange a tour of the principal South American capitals in connection with the visit to Chile.

JAMES T. CASE, M.D.

RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates. Address: Howard P. Doub, M.D., The Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary Treasurer* Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY *Secretary*, Harold Dabney Kerr, M.D., Iowa City, Iowa

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6 Ill.

SECTION ON RADIOLOGY, A.M.A. *Secretary*, U.V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary Treasurer*, John Day Plake, M.D., Mobile Infirmary, Mobile. Next meeting at the time and place of the Alabama State Medical Association meeting.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary*, Fred Hamels, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary* D.R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION *Secretary* Morris Horwitz, M.D., 2009 Wilshire Blvd. Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

PACIFIC ROENTGEN SOCIETY *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

SAN DIEGO ROENTGEN SOCIETY *Secretary* R.F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

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cology and Obstetrics, Graduate School of Medicine, University of Pennsylvania, Gynecologist to the Mount Sinai Hospital, Philadelphia, and S LEON ISRAEL, M D, F A C S, Instructor in Gynecology and Obstetrics, School of Medicine, University of Pennsylvania, Associate Gynecologist to the Mount Sinai Hospital, Philadelphia. A volume of 570 pages, with 108 figures. Published by Paul B Hoeber, New York. 2nd ed., 1946. Price \$7.50.

Book Review

L'UROGRAPHIE INTRA VEINEUSE By BERNARD FEBY AND PIERRE TRUCHOT. A volume of 214 pages, with 242 roentgenograms. Published by Masson et Cie, Paris, 1944. Price 320 fr.

The authors demonstrate that the prediction made in London in 1933 by von Lichtenberg, that 'all the advances which had already been realized anatomically by retrograde pyelography could be expected in the field of physiology and physiopathology from intravenous pyelography' has proved to be true. They present their subject in a rigidly logical sequence with a remarkably clear and simple style.

Emptying the bladder immediately before commencing the examination is recommended in order to avoid dilution of the dye in the bladder. Poor results are usually obtained if the specific gravity of the urine is below 1.018. Very little faith is placed in preliminary sensitivity tests for the dye. Only eight deaths were observed in approximately one million examinations in a period of over twelve years. The authors insist on compression of the ureters which, they believe, renders intravenous pyelography as valuable as retrograde pyelography save when morphologic information is primarily required. As a physiologic method wherein the

interpretation of results is difficult, excretory pyelography does not yield false information.

The comparative secretion of each kidney or the over all secretion of both cannot be assayed accurately, as early excretion may occur in one kidney or the other. Furthermore, secretion cannot be fully dissociated from excretion because the chemical and dynamic phenomena are closely interrelated. An excellent study of this interrelationship is presented.

The pathologic physiology in reference to the muscular function in excretion is extensively discussed from static (tonus) and dynamic (contractility) points of view. The tonus may be appreciated by close comparison of the urinary passages, which may appear hypotonic or hypertonic. The volume of the spaces and channels is not a reliable guide. The authors consider kinks in the ureter to indicate hypotonia, not morphologic abnormality. Further, horizontal levels in the calices are considered to be due to urine of different density and suggest retention in hypotonic cavities.

Although intravenous pyelography is not an examination for investigation of the lower urinary tract, it may occasionally supply some information which should not be neglected.

In their detailed review of pathological conditions nephrography is suggested as the usual sign of chronic nephritis. Such impregnation of the renal parenchyma with the radiopaque material, without outline of the calices, generally indicates impermeability of the renal filter. Intravenous pyelography is not considered dangerous in traumatic lesions of the kidney. In pregnancy, there is normal hypotonia and hypokinesia in 60 to 65 per cent of cases. In the case of tumor or cyst of the kidney, retrograde pyelography is nearly always necessary for control.

It is regrettable in such a valuable monograph that the illustrations are not of the best quality, due chiefly to the presentation of positive prints rather than the negative phase skiagrams.



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ABSTRACTS OF CURRENT LITERATURE

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Visualization of Otic Brain Abscess with Iodized Oil Edwin J Blonder J A M A 130 635-636 March 9, 1946

A case is presented in which lipiodol was used to delineate a temporosphenoidal abscess one week following a radical mastoidectomy, at which time the abscess had been uncovered. Roentgenograms revealed a 'beautiful filling of the abscess cavity'. A large rubber drain was then inserted, and subsequent films showed evacuation of the lipiodol within a week. The author reached the conclusion that iodized oil is useful in outlining an established otogenic temporosphenoidal abscess and in addition may have some therapeutic value.

Roentgen Appearance of the Anterior Wall of the Sulcus Sigmoides Eric Selander Acta radiol 27 60-65, Jan 31, 1946 (In English)

In roentgenograms of the mastoid region, there may be seen in some instances, double convex lines curving forward. The anterior line has been interpreted as the anterior wall of the sigmoid sinus and the posterior as the posterior border of the pyramid. Among 200 roentgenograms studied, the author found 54 displaying these double contours. On stereoscopic examination, however, the anterior contour was found to lie medial to the posterior in 52 of the 54 cases, a relationship which could not occur if the anatomical explanation mentioned above were correct. As a result of this observation, studies were made of 30 temporal bones, and roentgenograms were made with metal wires in place to outline the contours sharply. The posterior contour was found to represent the anterior wall of the sigmoid sinus, while the anterior contour was due to a bony eminence on the posterior surface of the pyramid. ELIZABETH A CLARK, M D

Adenocarcinoma of the Thyroid with Hyperthyroidism and Functional Metastases I. Studies with Thiouracil and Radio-Iodine Louis Leiter S M Seidlin, L D Marinelli, and E J Baumann J Clin Endocrinol 6 247-261 March 1946

Two cases of adenocarcinoma of the thyroid with functioning metastases and hyperthyroidism were studied with radioactive iodine as an indicator of the physiological activity of the metastases. In one patient the absence of functional thyroid tissue in the neck shown by the lack of retention of radioactive iodine proved that the metastases were responsible for the hyperthyroidism. Iodization aggravated the symptoms in one patient and produced a slight decrease in hyperthyroidism in the other. Thiouracil brought about a complete remission in both cases as judged by the effect on the general condition, basal metabolic rate, plasma cholesterol, body weight, and blood iodine. Upon withdrawal of thiouracil there was a prompt recurrence of hyperthyroidism in each instance. The urinary excretion of radioactive iodine was doubled during the period of maximum effect of thiouracil. From these results the authors conclude that thiouracil can suppress hormone production in metastases of adenocarcinoma of thyroid, just as readily as it inhibits this process in the hyperplastic thyroid of ordinary Graves' disease.

On the Normal Arthrogram of the Mandibular Joint. H H Jacobsen Acta radiol 27 93-97, Jan 31 1946 (In English)

In interpreting arthrograms of the temporomandibular joint, the mantle like shadow of the lower portion of the joint is easily explained, but there has been some question as to whether or not the upper joint cavity could produce a similar shadow. The author obtained positive evidence of such a shadow by injecting the superior cavity in two cadavers, making roentgenograms and subsequently dissecting the joints. The findings were further confirmed by arthrograms on a patient in whom the lower cavity was found at operation to be obliterated by disease. The shadows produced by the two cavities differ in several respects. (1) The contrast is greater in the superior cavity. (2) Views of the upper cavity show a space between the shadow of the condyle and the lower margin of the contrast medium, due to the interposed articular disk. (3) The contrast medium is above the level of the condyle in the superior cavity and around it in the inferior. (4) The contrast medium extends farther anteriorly in the superior cavity.

ELIZABETH A CLARK, M D

THE CHEST

Anatomy of the Blood Vessels of the Human Lung as Applied to Chest Radiology. Changes in the Lung Vascular Tree in Disease Processes. Emphysema and Asthma. Thomas Lodge Brit J Radiol 19 77-87, February 1946

The author concludes here a thesis, the earlier chapters of which, dealing with the anatomy of the pulmonary blood vessels and their normal radiographic picture have previously appeared (Brit. J Radiol. 19 1 1946. Abst in Radiology 47 529 1946). He begins by enumerating the structures which may be mistaken for the blood vessels and indicating their distinguishing features.

The lymphatics of the lung are not normally visible but in pathological processes they may give rise to a pattern which like that of the vascular tree, radiates outward from the hilum. There are two main groups: the superficial arranged in polyhedral rings in the pleura and the deep accompanying the arteries, veins and bronchi. The two groups communicate with each other. Both have valves. Circulation may be in any direction in the superficial but only toward the hilum in the deep group. The lymphatics may be involved by disease directly or by back pressure. The shadows on the film are thinner, more numerous and closer together than the other vascular markings. They may appear as polyhedral markings in the periphery or as radiating lines from the hilum.

The only other important shadows to be differentiated from the blood vessels are those due to linear fibrosis. These are almost invariably fine sharp lines not following the direction of any known vessel and even crossing the vessels at various angles. Occasionally in the presence of an inflammatory condition a bronchus may show the same degree of opacity as a blood vessel.

An increase in the number and size of the blood vessels is seen in the hyperemia which accompanies

many pathological states Active hyperemia is found in pertussis, pneumonia, diffuse bronchiectasis, and general pyrexia, especially in children In hyperthyroidism, also, there is invariably hyperemia with enlargement of the pulmonary artery Localized hyperemia may be observed around a localized area of inflammation Passive hyperemia will be seen in cardiac failure and obstruction of the pulmonary vein at the hilum

There is an absence of vessel markings in extreme degrees of emphysema, local or general, in pneumothorax, and in congenital cystic disease Crowding of the vessels may be due to diminished volume of a lobe or lobes, as in bronchiectasis, carcinoma, or the presence of a foreign body, or to external pressure as from pleural effusion Obliteration of the vessels takes place in pneumonic consolidations, collapse, pleural effusion, silicosis, metastatic cancer, and pulmonary edema and infarction In the so-called compensatory type of emphysema there is a fanning out of the vessels, and in the presence of a neoplastic mass they may be locally displaced or kinked Advanced upper lobe fibrosis due to fibroid tuberculous lesions may be accompanied by a generalized displacement

The most striking radiological feature in emphysema and asthma relative to the pulmonary vessels is their unusual clarity Vessels may be traced that are normally invisible In emphysema the vessels are apparently decreased in diameter This thinning is less frequent in asthma, and the smaller vessels, in contrast with emphysema, are often visible as a fine meshwork background

SYDNEY J HAWLEY, M D

Localisation of Foreign Bodies in the Chest A Practical Report. C J Hodson Brit J Radiol 19 70-76, February 1946

The author was able to assess the results of localization in a series of about 200 cases seen in an army chest center where it was the policy provided the risk of operation was reasonable to remove all foreign bodies over 1 cm in diameter lying in the rib plane or within the thoracic cavity, except certain ones in the heart As a result of his observations he concludes that the localization of such foreign bodies should be anatomical rather than geometrical All missiles cannot be accurately localized The greatest difficulty is offered by those lying in fibrin inside the chest wall those in the paravertebral tissues and small ones in or between the ribs

The general routine calls for preliminary postero-anterior and lateral films, with good penetration, made in the upright position These will allow a rough estimation of the location of the foreign body They should be followed by appropriate studies of greater accuracy including screening and tangential films, with observation of movement relative to anatomical structures In many instances fluoroscopic assistance at the operating table is required

Skin marking for foreign bodies outside the ribs and in the plane of the ribs is not considered satisfactory These are best localized by passing a needle to them under fluoroscopic guidance before operation For missiles just beneath the rib plane, tangential screening and films are recommended

Mediastinal foreign bodies should be carefully studied fluoroscopically to determine by position and motion

near what structure they lie A swallow of barium and a trickle of iodized oil down the trachea are often necessary Fluoroscopy at operation may be required, as foreign bodies in this location are often difficult to palpate

Paradiaphragmatic foreign bodies present special problems Sometimes it is not possible to tell whether they lie above or below the diaphragm A barium swallow, pneumoperitoneum, and pneumothorax are sometimes helpful

Careful study of its motion may indicate whether a foreign body lies within or adjacent to the heart and its relationship to the chambers Fluoroscopy is most important, for blurring by motion may interfere with demonstration on the film

Intrapulmonary foreign bodies are the easiest to localize There is often some degree of collapse Three things may simulate a foreign body on palpation a calcified node, a bronchus, or a missile track

SYDNEY J HAWLEY, M D

Primary Lung Tumors Ralph Adams J A M A 130 547-553, March 2, 1946

In the fifteen year period from 1930 to 1944, a diagnosis of primary lung cancer was established microscopically in 157 cases at the Lahey Clinic A clinical diagnosis of pulmonary cancer was made 199 times during the same period Among the 157 proved cases, males predominated, 128 to 29 One third of the adenocarcinomas occurred in women, while epidermoid cancer and the highly malignant oat cell cancer appeared almost exclusively in males Necropsy established the diagnosis in 5 instances Particular attention is called to 2 cases of metastatic carcinoma of the brain for which craniotomy was performed under the erroneous diagnosis of primary brain tumor, in neither instance had a roentgenogram of the chest been obtained

The five most common symptoms of pulmonary cancer encountered in these patients were cough (146), pain (85) sputum (83), hemoptysis (69), and wheeze (22) Dyspnea was recorded in 27 patients and was associated with pleural effusion in all but one

A diagnosis of primary cancer was made roentgenologically or stated as a positive suspicion in 152 cases, the diagnosis was missed in 2, in 3 cases no roentgenogram was taken Each of the 2 frankly misdiagnosed cases was called tuberculosis until examination of tissue obtained at thoracotomy in one instance and bronchoscopy in the other

The roentgen features suggestive of pulmonary carcinoma are the shadow of a central or peripheral mass localized expiratory emphysema, a large amount of emphysema causing shift of the mediastinum away from the lesion occasionally but more often toward the side of the lesion because of bronchial obstruction and atelectasis, signs of collapse, abnormal behavior of the diaphragm, and signs of mediastinal and pleural infiltration The value of careful fluoroscopy and lateral views in addition to postero-anterior films, cannot be overemphasized

Bronchoscopy was done in 122 cases with a positive diagnosis of cancer in 109 and negative in 13 This procedure should not be employed routinely Roentgenography is often of value in indicating when help may thus be obtained Rarely is a tumor seen bronchoscopically when its shadow is circular on the roentgenogram, as such tumors are nearly always peripheral

and arise beyond the major bronchi, no matter how close to the mid line they may appear on the postero anterior film. A lateral view will often delineate their peripheral position in respect to the hilum.

Carcinoma cells were found in the pleural effusion in 5 instances. Biopsy of palpable supraclavicular or axillary nodes or other metastases permitted microscopic confirmation of the diagnosis in 25 patients.

Eighty four of the tumors were epidermoid, 20 adenocarcinoma, 7 oat cell, 18 undifferentiated, and 28 not classified.

Efforts to control or to arrest advanced and inoperable cancer of the lung have been almost completely unsuccessful. Roentgen therapy has been abandoned as a curative measure. Sixty three cases in this series were found inoperable at the time the diagnosis of cancer was made. Ninety four cases were thought to be operable before the thorax was opened. Forty four patients had thoracotomy only. One patient had local excision of carcinomatous tissue invading the thoracic inlet in an unsuccessful effort to reduce pain. Nine patients died before leaving the hospital and 36 were dead or in terminal stages of the disease at the time of the report. Removal of the neoplasm by pulmonary resection was attempted in 49 cases. In this group there were 10 lobectomies with no hospital deaths and 39 pneumonectomies with 8 hospital deaths. (Technical procedures have reduced the hospital mortality in the last four years in 30 consecutive resections to 3.3 per cent.) Twenty three patients have died since leaving the hospital. At the time of the report, 4 patients were living with recurrence and 14 were living and well. The longest survival to that date was nine years.

During the fifteen year period, 7 microscopically confirmed non malignant tumors (6 bronchial adenomas, 1 myxochondroma) were encountered. All 7 patients were women. The symptomatology and diagnostic features in this group were similar to those of the cancer series. The diagnosis was suggested by roentgenography in all cases. Bronchoscopic removal of the tumor sufficed in 2 patients, 5 required pneumonectomy. All the patients were living at the time of the report.

Cystic Disease of the Lung Emanuel Kiosk, Arthur Bernstein and Aaron E. Parsonnet. *Ann Int Med* 24: 217-232 February 1946.

Cystic disease of the lung may be defined as any condition in which the lung parenchyma is replaced by sharply defined cavities containing fluid or air. It may be congenital, acquired or both, although the prevalent opinion seems to lean to a congenital origin. The authors exclude from their discussion dermoid cysts of the lung, echinococcus cysts and encapsulated interlobar accumulations of fluid or air.

Large solitary cysts occupying one or more lobes and often displacing the heart and mediastinum to the contralateral side are usually found in infancy and in early childhood giving symptoms of cyanosis and dyspnea, accompanied by physical signs of a tension pneumothorax. Roentgenologically these cysts appear as large areas of radiolucency with or without evidence of fluid. As a rule the cystic spaces are well defined and frequently they are traversed by linear strands of trabeculation.

A second form of cystic disease apparently congenital is one in which the pulmonary parenchyma is re-

placed by areas of cystic degeneration ranging from multiple milary cysts scattered throughout the lungs to large multilocular or unilocular cysts occupying one or more lobes. These cystic cavities communicate freely with bronchi and are lined with columnar ciliated or non-ciliated epithelium and show the usual architecture of a bronchus. Radiographically the pulmonary fields have a honeycomb appearance. The lung structure shows a large number of thin walled, sharply defined annular shadows without accompanying interstitial parenchymal infiltration. This roentgen appearance is especially diagnostic when the lesions are in the upper lobe, are bilateral and there is no distortion of the thoracic cage or retraction of the mediastinum as in the acquired forms of bronchiectasis. The direct communication with the bronchus can be demonstrated on bronchography and the grape like clusters of cystic spaces will be delineated.

Acquired pneumatocele or cystic disease is usually associated with respiratory infection, chronic bronchitis or peribronchitis, pulmonary fibrosis and emphysema, or bronchial asthma. It is evident that any pathologic lesion causing incomplete bronchial obstruction will be followed by obstructive emphysema with distention of the corresponding alveoli and thinning with resultant final rupture of the alveolar septa. Roentgenographically acquired pneumatocele presents itself as a poorly defined annular shadow devoid of pulmonary markings. A close scrutiny will show fine linear bands traversing the cystic space. It is obvious that from a roentgen and clinical point of view it may be very difficult to distinguish these acquired cysts from the congenital form of solitary cyst described above.

On the x ray film the differential diagnosis from a localized pneumothorax may be made by the establishment of a diagnostic pneumothorax. The cyst wall will then be separated from the thoracic cage and its cystic nature will become discernible. Removal of air will alter intraluminal pressure very little in cystic disease whereas well defined changes in the intrapleural readings will take place in localized pneumothoraces.

Aside from the large solitary cysts which balloon out under the influence of a check valve mechanism at the bronchial orifice and are fatal early in life, cystic disease seldom produces symptoms. Complications, however, are common. Probably the most frequent is hemorrhage which occurred in 4 of the author's 13 cases. The source of the hemorrhage has not been established. It is suggested that blood vessels coursing in the cyst wall unsupported on their luminary side may be prone to rupture under the strain of increased intrapulmonary arterial pressure. The next complication in order of frequency is infection with surrounding pneumonitis. A third complication is spontaneous pneumothorax.

Twelve illustrative case histories are included.

STEPHEN N. TAGER, M.D.

A Roentgen-Ray Classification of the Pneumonias, with Special Reference to the Tissues Involved. L. R. Sante. *J. Missouri M. A.* 43: 93-97 February 1946.

The purpose of this article is to clarify the roentgenographic types of pneumonic involvement. The major forms are as outlined below. Each is discussed briefly, and line sketches caricature the various types.

- A Lobar pneumonia
- 1 Pneumococcus type
 - 2 Staphylococcus type
 - 3 Caseous tuberculous pneumonia
 - 4 Tularemic pneumonia
 - 5 Friedländer bacillus pneumonia, pseudolobar stage
 - (a) Stage of lobar involvement
 - (b) Coalescence to form stage of pseudolobar distribution
 - (c) Rapid, extensive ulceration with multiple cavity formation
 - (d) Final stage of repair with dense fibrosis
- B Bronchopneumonia
- 1 Type caused by usual bacterial respiratory infections, with the radiographic appearance of a "bunch of grapes," occurring bilaterally in the lower lobes
 - 2 Friedländer bacillus pneumonia, four stages as in lobar pneumonia of this type, but with bronchopneumonic type of consolidation at the onset
- C Septic lobular pneumonia, associated with septicemia caused by *Streptococcus*, anaerobic *Streptococcus* or *Staphylococcus*
- D Glandular or lymphatic type pneumonitis
- 1 Tularemic pneumonia
 - (a) Primary pneumonic stage
 - (b) Glandular stage
 - 2 Measles pneumonia
 - 3 Whooping cough
- E Atypical pneumonia
- 1 Virus pneumonia with (1) hilar enlargement, due to central parenchymal infiltration, and peripheral spread, (2) fine lobular infiltration which may coalesce
 - (a) Influenzal pneumonia
 - (b) Psittacosis
 - (c) Mongoose virus
 - (d) Mouse virus
 - (e) Undoubtedly many others
 - 2 Rickettsial pneumonia
 - 3 Protozoal pneumonia
 - 4 Drug sensitization pneumonia
 - 5 Undoubtedly many others of this type
 - (a) Typhus fever
 - (b) Rocky Mountain spotted fever
 - 6 Lipoid pneumonitis

SYDNEY F. THOMAS, M D

Clinical and Roentgenographic Manifestations of Primary Atypical Pneumonia, Etiology Unknown. John B McDonald and Bernard Ehrenpreis *Ann Int Med* 24 153-169 February 1946

The authors present a clinical study of 75 cases and roentgenologic observations in 135 cases of atypical pneumonia

What is regarded as the typical syndrome is a cold of three to ten days' duration followed by suddenly developing chills fever shortness of breath cough headache sore throat, and generalized aches and pains. This syndrome was present in 47 per cent of the authors' series. In another 40 per cent there was a history of sharp pain in the chest aggravated by cough and deep inspiration. Physical signs were not comparable in degree with the extent of the lesion as disclosed by the roentgenogram.

Roentgenographically the lesions are of two main

types (1) benign circumscribed pneumonia (2) disseminated focal pneumonia. The benign circumscribed lesion is fairly well localized but not sharply defined. It is of uniform density and is located usually in the lower lobes. The disseminated focal type produces a picture of diffuse, rather coarse mottling, the foci measuring from 2.0 to 5.0 mm. There were only 9 cases of this focal type in the authors' series of 135 cases.

The lesions of atypical pneumonia have been found chiefly to show a segmental lobular distribution. The transparent lobules are surrounded by increasingly thickened perilobular septa until the lobules disappear, either due to collapse or exudate, thus leading to the picture of consolidation. The conspicuous feature appears to be the engorgement of the perilobular structures or septa, which is seen in the initial stages and persists around the re-illuminated lobule during the resolution of the process.

Primary pulmonary coccidioidomycosis and, to a lesser extent, pulmonary tuberculosis require differentiation. The chief distinguishing features are the infrequent involvement of the upper lobes in atypical pneumonia and its rapidity of resolution. Basal involvement, in the form of consolidations lodged in the cardiophrenic angle, was a predominant feature in over 80 per cent of the cases here considered.

Atypical pneumonia has a high morbidity but a low mortality, and complications are infrequent. In 9 patients of the present series, a slight pleural effusion occurred. One patient had a moderate pleural effusion which required prolonged hospitalization. Three lung abscesses developed, probably from secondary pyogenic invaders, all healed spontaneously.

STEPHEN N. TAGER, M D

Complications of Bronchial Asthma and Their Association with Bronchostenosis. James A Mansmann and Leslie H Osmond *Pennsylvania M J* 49 513-517, February 1946

One of the cardinal features of bronchial asthma is a narrowing of the bronchi as a result of spasm, a bronchial plug edema, or actual stenosis. Such occlusion may be partial or complete. It is the mechanism which precedes the development of such other complications as emphysema atelectasis, bronchiectasis spontaneous pneumothorax, and mediastinal emphysema, and its early discovery is of the first importance. Bronchostenosis may be due to infection or to an allergic factor with infection superimposed. To determine whether or not allergy plays a role, the authors suggest examination of a nasal smear for the presence of eosinophils.

A properly conducted roentgen examination has been found of considerable help in the recognition of bronchostenosis associated with bronchial asthma. The roentgen findings are dependent upon two outstanding disturbances of function resulting from stenosis, (1) movement of air entering or leaving the segment of pulmonary tissue beyond the site of the stenosis is inhibited, (2) bronchial secretions are retained distal to the stenotic region. A double exposure film (or two films) taken at full inspiration and expiration will show a shift of the heart shadow of from 5 to 10 mm toward the affected side. This shift can also be seen fluoroscopically. There is usually a thickened fuzzy outline of bronchovascular markings in the affected area, and there is frequently a fan like area of increased den-

sity through which bronchovascular markings can be seen. Films are reproduced demonstrating the cardiac shift, and bronchograms revealing the constriction.

Treatment is directed toward the causative factor—allergy or infection. Bronchoscopic dilatation and bronchodilating drugs are indicated.

JOSEPH T. DANZER, M.D.

Lipoid Pneumonia in Adults W. A. Sodeman and B. M. Stuart. *Ann Int Med* 24: 241-253, February 1946.

The term lipoid pneumonia should be strictly confined to a productive inflammation of the lung in which the fundamental histologic alterations are directly attributable to the presence of foreign oil or fat. In adults the condition is likely to be due to the use of mineral oil as a laxative, while in children vitamin oils are more commonly responsible.

Clinically, the expressions of lipoid pneumonia may be grouped as follows:

- I Asymptomatic
 - A Not recognized before autopsy
 - B Physical findings leading at times to a roentgen diagnosis
 - C Findings on roentgen examination without remarkable physical findings
- II Symptomatic, with the findings in B and C, above, expressed as
 - A Acute pneumonitis simulating aspiration pneumonia, protracted bronchopneumonia
 - B Recurrent acute pulmonary infection with clinical evidences of repeated attacks of bronchopneumonia
 - C Low grade bronchial or pulmonary infection which leads to roentgen findings
 - D Picture simulating carcinoma of the lung with cough, pain in chest, and related symptoms leading to roentgen findings which simulate those of carcinoma
 - E Lipoid pneumonia incidentally found in association with other pulmonary disease
 - F Association of any of the above pictures with a clinical state predisposing to aspiration, such as bulbar palsy, multiple sclerosis, other causes of dysphagia, and severe debilitating disease

The frequency of asymptomatic cases is evident from reports in the literature. In one autopsy series of 41 cases, 25 per cent were without symptoms, and in 4 of these roentgen studies were negative.

The roentgenologic findings vary widely. In many instances exaggeration of the bronchovascular markings in the lower lobes may be the only evidence. Small areas of increased density may appear along the bronchial markings. Evidence of fibrous and atelectatic areas may develop in the surrounding parenchyma. Nodulation may appear and when lesions reach sufficient size, areas interpreted as consolidation are seen. The areas of nodulation are frequently very sharply defined. At times they may be feathery. Again they favor the bases, especially the right base and tend to spread from the hilar areas. Superimposed secondary infection may cause the shadows to vary from time to time. Compensatory emphysema occurs. Confusion may occur with bronchiectasis, tuberculosis, primary and secondary carcinoma, pulmonary infarction, acute bronchopneumonia, unresolved pneumonia,

fungus infections, and pneumoconiosis. Obviously *no roentgenologic picture is diagnostic of lipoid pneumonia*.

Clinically, also, lipoid pneumonia may simulate a wide variety of pulmonary conditions. Of the symptomatic types, that designated above as A—acute pneumonitis—presents the most dramatic picture, leading frequently to a diagnosis of acute bronchopneumonia. In bronchopneumonia which runs a protracted course, oil aspiration should be suspected as the cause. The type of oil may determine the symptomatology. Animal oils, especially cod liver oil, are highly irritating, whereas some vegetable oils are relatively non-toxic. Cod liver oil is more likely to give an acute picture of this type than is mineral oil.

Another of the more striking clinical pictures is that designated as B—recurrent pulmonary infection with clinical evidence of repeated attacks of bronchopneumonia. A case of this type is reported in some detail. A case of Type D simulating carcinoma of the lung is also presented.

The clinical diagnosis rests primarily upon a strong suspicion of the disease when other explanations of the clinical picture are not well established. A history of the use of an oil either intranasally or by ingestion increases the probability that the condition is due to oil aspiration. Physical findings are of little differential value but are extremely important since they lead to roentgenologic investigation. Slow change in the character of the lesions on serial examinations, particularly in the lower lobes, plus an unresolved bronchopneumonia and roentgenologic findings out of proportion to clinical symptoms and signs should lead to attempts to obtain the clinical associations mentioned above. Confirmation may be sought by demonstration of oil in the sputum several days after oil has been discontinued as nose drops or by mouth. This may be done by letting sputum stand then covering it with a cigarette paper to absorb the oil droplets, or by microscopic examination.

STEPHEN N. TAGER, M.D.

Chest X-Ray Survey of Repatriated Prisoners of War from Japanese Camps H. H. W. Brooke. *Canad. M. A. J.* 54: 141-144, February 1946.

A chest x-ray survey was made of 1,507 prisoners of war repatriated from Japanese camps. Approximately 100 of the 1,507 had chest films made at U.S. Naval Stations within two weeks of the time of their release from the prison camps. In the remainder of the group the radiographs were made within six to eight weeks after removal from the prison camps. All but a very small number had been held in prison camps since December 1941 subsisting on a totally inadequate diet and working for the most part at road building and underground in mines. All of the men suffered from beriberi in an advanced clinical stage.

In reviewing these chest films the author has divided the study into three parts. First in regard to the *thoracic cage* all of the radiographs appeared to indicate a physiological age considerably beyond the chronological age. There was a depletion of the calcium content of the bone structures and 17 men showed healing rib fractures with poor calcium content in the callus formation. In 2 cases of multiple posterior fractures entire rib segments appeared to be missing, which may have been due to previous open drainage.

The pleural and pulmonary lesions are presented in tabular form. Questionable minimal tuberculosis was found in 24 of the series, active minimal tuberculosis in 33, moderately advanced tuberculosis in 7, and far advanced tuberculosis in 2. There were discovered, also, 3 cases of lobar pneumonia, 7 of atypical pneumonia, and 1 of pneumonia with cavitation, due possibly to Friedländer's bacillus. There were 36 cases of active or inactive pleurisy and 5 of pleurisy with effusion.

The cardiovascular studies were concerned largely with the size and shape of the heart. In the entire series of 1,507, only 3 persons were found having a cardiothoracic index of over 0.5. All of these had an aortic rather than a mitral or globular type of cardiac configuration. Cardiac measurements were made on 435 chest radiographs. As far as could be determined from a study of these films, there was no evidence of definite enlargement of the heart due to beriberi in any instance. **BERNARD S. KALAYJIAN, M.D.**

Spontaneous Pneumothorax in Healthy Young Adults, with Particular Reference to the Ethological Role of Aerial Ascent. Eric M. Heath. *Am J M Sc.* 211: 138-143, February 1948.

In a series of 88,916 man flights in an altitude chamber, only one spontaneous pneumothorax occurred. In one other subject, symptoms due to a pre-existing partial pneumothorax necessitated descent from a simulated 17,000 feet. Each "flight" was of ninety minutes' duration, from ground level to a simulated altitude of 30,000 feet at a rate of about 2,000 to 3,000 feet per minute with a peak altitude being maintained for about fifteen minutes.

In 771 persons undergoing an explosive decompression "flight," which involved a change of from 8,000 feet to 20,000-23,000 feet in less than one second, there was no instance of spontaneous pneumothorax. This type of flight simulated the effect of decompression by gunfire of a pressurized cabin flying at 20,000 feet.

The common explanations for the mechanism of spontaneous pneumothorax are (1) rupture of an emphysematous bleb, (2) rupture of the visceral pleura and (3) interstitial emphysema of the lungs with an escape of air to the pleura through the mediastinum.

For purposes of comparison a survey of the incidence of spontaneous pneumothorax was compiled from the literature and the clinical records of an Army Regional Hospital.

From these data it would seem logical to conclude that changes of altitude encountered in normal aerial flight have no appreciable bearing on the precipitation of spontaneous pneumothorax in individuals with no apparent pre-existing lung disease. The occurrence of spontaneous pneumothorax during normal aerial flight is so rare that it is of no practical significance and the impression that normal aerial flight is likely to produce spontaneous pneumothorax in a healthy subject is an erroneous one. It seems likely that the occurrence of spontaneous pneumothorax during aerial flight is merely coincidental.

BENJAMIN COPLEMAN, M.D.

Displacement of the Mediastinum and Its Practical Significance. A. Brunner. *Schweiz med Wchnschr* 76: 145-150, Feb 23, 1946.

The mediastinum may shift to the side of less pressure if a pressure difference exists in the chest. If the

pressure of one side is elevated, one speaks of "displacement", if it is reduced, of "pulling to the diseased side". Sometimes the mediastinum does not give under the pressure change, and this leads to the so-called mediastinal hernias. Increased pressure leads to the pulsion type of hernia, decreased pressure to the traction type. The former often occurs in pressure pneumothorax. Traction hernias in the absence of a pneumothorax of the opposite side are rarely described, and two such cases are briefly reported. In spite of high grade collapse of one lung, residual exudate can remain latent in the chest for several years, finally to be manifested when it breaks into the lung and leads to gross expectoration. Similarly a free pleural opening may be kept up by inflation from the adjacent lung without much obvious evidence.

LEWIS G. JACOBS, M.D.

Displacement of the Mediastinum Due to Pulsion by a Caseous Tuberculous Lung without Pleural Effusion. Report of a Case in an Infant. John Fleck Miller and B. H. Kean. *J Pediat* 28: 200-203, February 1946.

A case of pulmonary tuberculosis in an infant with enlargement of the caseous lung sufficient to displace the mediastinum toward the other side is described. The chief interest in this case lies in the similarity of the clinical and roentgenologic findings with those of pleurisy with effusion. Flatness to percussion, absence of breath sounds over the entire left side of the chest and displacement of the heart to the right were considered diagnostic of effusion in the left pleural cavity. Furthermore, the left intercostal spaces bulged and the left side of the chest was splinted and fixed in a way usually characteristic of fluid. The roentgenogram showed homogeneous opacity over the entire left side of the chest, with the heart and trachea shifted to the right, apparently confirming the clinical diagnosis of effusion. On thoracentesis, only a small amount of tuberculous caseous material was obtained. The actual situation was correctly evaluated only at autopsy.

Wedge-Shaped Shadows of Fleischner. Franco Fosatti. *Radiol med (Milan)* 32: 27-37, February 1946.

In 1925 Fleischner (*Klin Wchnschr* 4: 875, 1925) described wedge-shaped shadows which project from the right side of the mediastinum into the right pulmonary field. He interpreted these shadows as interlobar mediastinal collections of fluid. Fosatti has studied a large number of these cases and he is convinced that the majority of such shadows are due to atelectasis in the right middle lobe. He emphasizes the lordotic position for their visualization.

CESARE GIANTURCO, M.D.

Roentgenological Picture of the Coarctation of Aorta and Its Anatomical Basis. H. Gladnikoff. *Acta radiol* 27: 8-19, Jan 31, 1946. (In English.)

Because of the progress in thoracic surgery and development of technics of operation upon the great vessels, the diagnosis and roentgenologic evaluation of coarctation of the aorta have become more important. The author reports 3 cases in which resection and anastomosis were done and offers an anatomical explanation for the characteristic roentgenologic appearance. In

addition to the notching of the ribs because of pulsations of the intercostal arteries which act as collaterals and hypertrophy of the left ventricle because of the increased load upon the heart, four other variations from the normal roentgenogram have been described (1) convexity of the left border of the superior mediastinum, (2) indentation in the posterior mediastinum (3) lack of visualization of the aorta beyond the ascending portion and (4) convexity in the left side of the barium filled esophagus at the level of the indentation of the posterior mediastinal shadow

The author made anatomical observations during operation in the 3 reported cases and concluded that the convexity of the superior mediastinum is caused by the dilatation of the left subclavian artery and that the indentation of the posterior mediastinal shadow corresponds with the junction of the left subclavian and the aorta. He observed an increased tautness of the aorta and, therefore, a decrease in the physiological curves as well as the associated narrowing at the insertion of the ligament of Botalli thus explaining the incomplete visualization of the aorta physiologically rather than as due to actual anatomical lack of continuity. In none of the cases could a widening of the esophagus to the left be demonstrated, and the author believes this finding, when it does occur, is only apparent because of the impression on the esophagus of the dilated subclavian above the region of indentation produced by a normal aorta.

ELIZABETH A. CLARK, M.D.

Constrictive Pericarditis T. Holmes Sellors, Brit J Surg 33 215-230 January 1946

This article is based on a Hunterian Lecture delivered at the Royal College of Surgeons April 28 1944. In constrictive pericarditis the heart is compressed and its normal action is restricted as a result of adhesions producing a layer of dense fibrosis in the pericardial tissues. The essential features of such compression are based on the increase in venous blood pressure with consequent engorgement and edema. Ascites and enlarged liver are constant findings. Pulmonary congestion is clinically and radiologically absent and this is important in the differential diagnosis from congestive heart failure.

The heart muscle is relatively normal but cardiac rhythm is abnormal and all types of irregularity from extra systoles to auricular fibrillation are encountered. Radiologic study reveals limitation of movement which is not uniform. There is increased width of the supra cardiac shadow due to dilatation of the superior vena cava and innominate veins. Other radiological findings are calcification in plaques or bands, reduced excursion of the aortic arch and raising of the heart on swallowing (the swallowing sign of Rabin).

Current literature submits three possible causes for origin of constriction—tuberculous infection, old pyogenic pericarditis and idiopathic factors. The author's evidence supports tuberculous infection as chief causative agent. The massive avascular collagen of hyaline character in old cases suggests the end result of widespread and devastating inflammation with great destruction of tissue. This picture is similar to that seen in advanced healing stages of tuberculous inflammation. Pockets of fluid or inspissated pus and debris are often present. Plaques of calcium tend to burrow into the heart muscle.

Surgical removal of the restraining pericardium is the only treatment for established pericardial constriction.

Excision should aim primarily at freeing the ventricles. The usual procedure is to resect the anteriorly placed pericardium and to carry the dissection outwards over the apex and around the left border of the heart. The effects of the pericardiectomy are to restore the pulse pressure to normal. A lowering of the venous pressure and reduction of ascites and liver size may be noted within a few weeks, but full and final improvement should not be expected within twelve to eighteen months. Published results give an average of over 50 per cent of cases cured or improved, with an operative mortality of 33 per cent and about 10 per cent subsequent deaths.

The author appends 5 case reports. *Case 1* An 11-year old girl had characteristic signs of constrictive pericarditis. Frequent aspirations of pericardial effusion gave no relief. Radiologic examination showed a huge globular contour of the heart with complete absence of pulsation. At operation the pericardium was found to constitute a massive covering to the heart over 1.0 cm thick. The excised tissue showed an active tuberculous process. Two years after operation there was marked improvement. Kymography showed free movement of the left heart border but complete immobility on the right.

Case 2 A man aged 43 years had constriction resulting from a suppurative pericarditis following an empyema. Operation revealed fibrosis of the pericardium and excision was followed by a good recovery.

Case 3 An 11-year-old boy had polyserositis accompanied by constrictive pericarditis. Conservative treatment was carried out for eighteen months to allow the active tuberculous process to become quiescent. Operation was well tolerated but death occurred from ventricular fibrillation.

Case 4 A boy of 18 years showed all the evidence of pericarditis. Within eight months after operation recovery was complete. The pathological report was fibrosis of tuberculous origin.

Case 5 A man of 48 years had symptoms of three years duration. X-ray examination showed increase in the transverse diameter of the heart with calcification of the pericardium mainly on the right ventricle and left auricle. (An excellent reproduction of a lateral chest film shows the calcium forming an irregular mesh work round the auricles and great veins.) At operation calcium plaques were found distributed in the auriculo-ventricular grooves and over the auricles and great veins. Dissection was carried out and the pathological examination showed fibrosis with no evidence of tuberculosis. Ten weeks after operation all symptoms had disappeared.

MAX CLIMAN, M.D.

Pericarditis with Effusion Following Infections of the Upper Respiratory Tract David A. Nathan and Richard A. Dathe, Am Heart J 31 115-130 February 1946

The authors report 8 cases of pericarditis with effusion following apparently trivial acute upper respiratory tract infection without pulmonary disease. In 6 of the 8 cases the infection was described as either a cold, or sore throat or a nasopharyngitis. In 2 cases there was no history of an infection but the patients had a non-productive cough. Roentgenograms reproduced from 5 of the cases show enlargement of the cardio-pericardial shadow with subsequent recession.

HENRY K. TAYLOR, M.D.

THE DIGESTIVE SYSTEM

Roentgenology of the Small Bowel E A Zimmer

Gastroenterologia 70 113-170, 1945

This is a 57-page essay on all aspects of the roentgen diagnosis of disease of the jejunum and ileum. It covers the position of the bowel, congenital variations, abnormal gas shadows, foreign bodies, neoplasms, small bowel resections, inflammatory processes, the normal small bowel pattern, and methods of examination. The subject is well covered by an adequate though concise text and numerous illustrations including drawings and reproductions of roentgenograms. Although there is little new material presented, this is a very good review.

LEWIS G JACOBS, M D

Early Diagnosis and Management of Small Intestinal Obstruction. Claude J Hunt. Surgery 19 237-250, February 1946

Small intestinal obstructions are of two major types: (1) those on the surface of the abdomen as strangulated hernias, and (2) those hidden within the abdomen. Strangulated hernias are easily diagnosed and, as a rule, reach the surgeon promptly. For these, immediate operation is recommended. Diagnosis in the second, or hidden group is more difficult and is often delayed with the result that serious complications may ensue before proper treatment is instituted.

Intra abdominal obstructions are further divided into (1) those due to conditions which do not immediately interfere with the blood supply and thus do not require emergency operation and (2) those due to conditions which do interfere with the blood supply and must be promptly relieved if gangrene of the bowel is to be avoided. In the first group are the simple obstructions due to bands of adhesion, intrinsic lesions, as neoplasms and gallstones, and inflammatory conditions, in the second are strangulated internal hernia, volvulus, intussusception and mesenteric thrombosis. In simple obstruction rigidity and localized abdominal tenderness are absent. Their presence is strong evidence of strangulation of a loop of bowel and danger to the blood supply.

There are few early physical signs in intestinal obstruction. Colic is frequently not well localized. Bowel movements and the passage of gas may occur even after obstruction is present. The result of emptying of segments of bowel distal to the point of obstruction. Peristalsis may be visible through the abdominal wall. Vomiting depends on the duration and level of obstruction.

Radiologically, collection of gas in the small bowel may be considered as synonymous with obstruction in the adult, though in very young children this is a normal finding. Gas may collect proximal to an obstructed point within a few hours. In simple obstruction the gas may be centrally located with a transverse long axis, while in loop obstruction the dilated loops may assume no definite pattern and proximal bowel distention is slow in developing. Thickening of the walls separating loops suggests fluid or exudate. Gas in the large intestine in contrast to that in the small bowel assumes a vertical longitudinal axis, the bowel wall is thicker and haustral markings are present.

'Stepladdering' of the small bowel indicates advanced obstruction, but the diagnosis is possible long before this condition develops. With complete small intestine obstruction there is little or no gas in the

colon while with colonic obstruction, there is usually no regurgitation through the ileocecal valve and the small bowel is free of gas. In paralytic ileus, gas may be present in both the small and the large bowel, repeated films will help to make the diagnosis more certain. Consideration must also be given to the silent and painless abdomen as a differential point in diagnosis.

The Miller Abbott tube has been found useful both in the non surgical treatment of obstructions due to localized inflammatory processes and as an adjunct in operative cases, either preoperatively or postoperatively. Patients with clinical and radiographic evidence of postoperative small bowel obstruction have frequently recovered following decompression with the Miller-Abbott tube, without operation.

Intussusception may frequently be diagnosed and reduced through use of the barium enema. Small intestinal obstruction may be studied with barium introduced through the Miller Abbott tube.

Case histories illustrating the different causes of intestinal obstruction, with roentgenograms and pathologic findings, are included.

J E WHITELEATHER, M D

Volvulus of the Cecum—with Left Sided Colon. Report of Case J H Brady. California & West Med 64 77-79, February 1946

A case of volvulus of the cecum is reported, which was directly related to incomplete rotation and deficient fixation of the bowel. The patient was a white male, of seventeen years, admitted to the hospital as an emergency case. His illness began suddenly the previous day with intestinal cramps, there were no bowel movements and no passage of blood or mucus. The abdomen was distended and intermittent vomiting occurred becoming fecal in character. There had been several previous attacks of cramps, vomiting and diarrhea beginning in childhood. The general examination was negative aside from the abdomen, which was distended and tympanic, with borborygmus and metallic tinkling. No masses could be felt either abdominally or rectally. Enemas were administered without effect. A barium enema study showed all of the colon to be on the left side of the abdomen where three distinct loops were present, representing the transverse, ascending and cecal portions.

At operation the cecum, appendix, distal ileum, and ascending colon were found to be greatly distended. On following down the loop of intestine what appeared to be a continuous ileocecolic mesentery was found. The entire loop had twisted clockwise having as its axis, apparently the superior mesenteric vessels the volvulus being 270 degrees. There were many old adhesions present which had to be freed before it was possible to untwist the loop. Even then, the colon did not seem to be entirely free but it was possible to bring the cecum into the right lower quadrant. On examination of the ileum it was found that there was a Meckel's diverticulum about 10 inches from the ileocecal valve. After reduction of the volvulus a cecostomy was performed but no attempt was made to remove the diverticulum.

During the latter part of the patient's hospital stay he had some intermittent cramps, and these increased gradually following his discharge. Fecal vomiting again occurred and a second operation was done elsewhere. The cecostomy appeared to be functioning normally but an obstruction was found in the upper

ileum, apparently produced by old adhesions. These adhesions were so dense that it was necessary to resect two inches of the ileum and do a side to-side anastomosis. Death occurred about eight weeks later. At autopsy, it was found that the entire abdomen had been involved in a severe peritonitis. There was a corrected malrotation of the colon. The cecostomy was open, and there was no obstructive lesion anywhere. The mesentery of the ascending colon was fully as long as that of the transverse colon, allowing great mobility of the ascending colon and cecum. All the other abdominal organs appeared normal.

A brief review of the literature is included.

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Amebic hepatic abscesses are usually single (65 per cent), occurring in the right lobe of the liver (85 per cent) near the dome or on the inferior surface near the hepatic flexure. Fever is the most common systemic manifestation (85 per cent), diarrhea may or may not occur. Pain over the liver is the most common local finding. Hepatic enlargement is also a frequent observation.

In 1927 Craig introduced a specific complement-fixation test, though he considers examination of stools, exudate, and pus for amoebae as a more satisfactory diagnostic procedure. Roentgen examination is important, including an upright fluoroscopic study. In uncomplicated liver abscess, bulging and localized doming of the diaphragm are demonstrable. It is possible to distinguish subphrenic abscess complicating a liver abscess from that due to other causes. In the former there is characteristically an obliteration of the cardiophrenic angle in the anteroposterior roentgenogram and obliteration of the anterior costophrenic angle in the lateral view. In subphrenic abscess due to other causes there is obliteration of the costophrenic angle in the anteroposterior view and of the posterior costophrenic angle in the lateral view. Abscess in the left lobe produces pressure changes in the barium filled stomach.

Pleuropulmonary complications of amebiasis occur in from 3 to 59 per cent of the cases reported. This complication is usually a result of direct perforation from an amebic hepatic abscess. Rarely if ever is primary infection of the lung observed, but a few cases of amebic bronchitis have been described. The cardinal signs of a bronchohepatic fistula are (1) high fixed right diaphragm, (2) abscess mass near the diaphragm and involving the lung, (3) column of fluid extending

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The general condition of the patient should be noted, although a patient with an abdominal wound may be initially in relatively good condition, continued absence of shock and of abdominal rigidity is against a diagnosis of peritoneal perforation. Vomiting is not particularly indicative, but if swallowing blood can be excluded, hematemesis indicates esophageal or gastric damage. This is of importance in blast injuries.

Inspection of the wound may give important information as to the location of the fragment. Secretion from the wound is important, its nature will indicate perforation of the bladder, urethra or bowel. Hemorrhage is seldom a diagnostic aid, although bleeding which cannot be controlled by a pressure dressing may be of intra abdominal or retroperitoneal origin. Abdominal palpation should be done, especially for abdominal rigidity but the findings should be carefully evaluated as they may be misleading. Tenderness in the renal region does not of itself signify renal damage. Digital examination of the rectum for tears and foreign bodies is important, blood on the examining finger is confirmatory evidence of damage. Coincident rectal examination and catheterization may assist in locating damage to the urethra. Study of the urine for blood and filling the bladder with a measured amount of fluid to determine if all of it can be recovered will determine the status of this organ. Auscultation is less important in the abdomen, but the presence of peristalsis is against intraperitoneal damage.

Roentgen examination is used principally to locate foreign bodies, the condition of the patient usually precludes special technics. The presence of fractures, thoracic abnormalities, subcutaneous emphysema, diaphragmatic hernia or subphrenic gas may be helpful signs, especially as regards the course of the bullet.

Thoraco abdominal wounds present special problems, a single injury may lead to two diaphragmatic perforations, and their preoperative diagnosis is important because of the need for thoracotomy in such cases. Dysphagia may indicate an esophageal injury. Proper evaluation of all information should determine the type of treatment and the urgency of the case.

LEWIS G. JACOBS, M D

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Each of the 75 patients examined complained of low back pain with sciatic radiation. 56 of the myelograms showed definite pathologic changes, 3 were questionable, 15 were normal, and 1 was incomplete. Operations were performed on 30 patients, and in all but one instance the myelographic findings were confirmed.

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The first case showed all three conditions, circumscribed and diffuse osteoporosis and a reflex nervous dystrophy, occurring in the same part at the same time. The second patient had a diffuse type of osteoporosis associated with some muscular atrophy about the involved joints. Twenty-one months later the involved bones had recalcified and the clinical picture was now that of a post-traumatic reflex dystrophy of the extremity. Roentgenograms in the third patient showed what appeared to be a diffuse post-traumatic osteoporosis of the entire carpus and adjacent bone structure superimposed upon a previously existing circumscribed osteoporosis of the semilunar bone, otherwise known as Kienbock's disease.

All of these conditions are believed to be due to a functional disturbance of the vasomotor mechanism of the parts involved, differences in the clinical and roentgenological findings merely representing variations in the degree of involvement. This variance in one or another phase of the condition has given rise to a varied terminology referring to what is in all probability the same condition. The more common terms employed in the literature are Sudeck's bone atrophy, acute bone atrophy, post traumatic osteoporosis, reflex dystrophy of the extremities, reflex nervous dystrophy, segmental angiospasm, and minor causalgia.

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number 11 were operated upon. Ten of these had fissures of the cartilage of the patella, and the eleventh of an anomalous ossicle.

Clinical symptoms are: (1) sharp pain, (2) instability, (3) enlargement of the knee region, and (4) inability to bear weight. The patient may feel or hear a click or sandpaper like grating on active flexion or extension. Physical findings include effusion and tenderness which becomes localized to the patella. Passive rocking or percussion of the patella produces pain. With the stethoscope, high pitched cracking sounds are heard on active moving of the knee. Crepitation may also be felt on transverse passive displacement with pressure (contact test), or on active contraction of the quadriceps with the leg in maximal extension. Pain is experienced during this latter procedure when mild manual resistance is applied to the superior pole of the patella (resistance test). Accentuation of subpatellar crepitus may be obtained by flexion of the thigh to 90 degrees while actively flexing and extending the knee (stretching test). In long standing cases, there may be synovial thickening, effusion, and inability to kneel. Fissures of the articular cartilage of the patella may coexist with semilunar cartilage tears or displacements, or with tears of other ligaments about the knee, and one should not strive to restrict the diagnosis to a single entity in every case.

Radiographic findings are few. Views made in the anteroposterior, lateral and jackknife positions in the author's series revealed 11 instances of anomalous patellae, classified as unilateral and bilateral bipartite, unilateral and bilateral tripartite, and unilateral quadrupartite. In 2 additional cases a circumscribed area of subchondral atrophy was found in the central portion of the patella. The roentgen studies confirmed the clinical findings of increased fluid or synovial thickening.

Conditions requiring differentiation include free intra articular bodies, synovial polyps, osteochondromatosis, chronic infectious semilunar cartilage tears and displacements, osteoarthritis, fractures, and osteochondritis dissecans.

Treatment follows two plans. Acute injuries are given a chance to heal, while recurrent and old injuries which have failed to heal are subjected to arthrotomy. Operative procedures in general follow two patterns: (1) resection of the involved cartilage area with perforations into the medullary cavity of the patella to facilitate the reparative process, (2) removal of the entire patella or anomalous ossicle. Acute injuries are followed by recurrences of symptoms in a high percentage of cases. Patients operated upon have serviceable knees but are not able to perform strenuous duty or exercise and should be warned against such activities.

Pathological changes include a partial loss of hyaline matrix, a secondary unmasking of the fibrils of the cartilage and the presence of superficial and deep fissures. The flat cells normally situated in the outer or tangential layer were found to be either absent or replaced by groups or nests of actively growing elliptical cells resembling those in fibrocartilage. There was evidence of partial repair as exemplified by proliferating young cells on the articular surface and on the walls of the fissures. It appears that this meager attempt at healing was aided by the contiguous synovial fluid without benefit of granulation tissue.

Excellent photographs, diagrams and roentgenograms illustrate the normal and pathological structure of the patella.

J. E. WHITELEATHER, M.D.

A Case of Tibia Recurvata. Karen Lubchitz. *Acta radiol* 27: 81-87, Jan 31 1946. (In English.)

Tibia recurvata may occur (1) as a congenital anomaly, (2) as a result of metabolic disease in which there is generalized softening of bone, (3) as a result of local softening (a) from some unknown cause during the growth period, (b) following a lesion of the epiphyseal cartilage, or (c) in peripheral, and possibly spastic paresis of the extremity in conjunction with flexion contracture of the knee and hip, (4) as a static dynamic deformity following ankylosis at the knee joint or in conjunction with hip joint disease in which severe flexion contraction has been produced.

In the author's case an anterior roentgenogram of the knee on the affected side showed the articular interspace apparently obliterated and the patella lower than on the opposite side. In the lateral view, however, it was seen that the interspace was fully preserved and that the curious frontal view was due to a deformity of the upper part of the tibia, the articular surface of which was placed proximo-anteriorly instead of as normally proximo-posteriorly. Whereas on the normal side there was an angle of 173 degrees opening backwards in the upper part of the tibial diaphysis about opposite the tuberosity of the tibia, there was on the side of the deformity an angle of 160 degrees opening forward, and here the tuberosity seemed to be lacking, or at least there was only a slight indentation corresponding to the insertion of the inferior patellar ligament. The fibula showed a slight convexity from before backward, parallel to the arc described by the tibia.

The deformity is usually an incidental finding, without symptoms. Including the present example, there appear to be only 7 cases in the literature in which the condition could be regarded as a primary anomaly. The author believes that these cases represent the end result of an endocrine disturbance during the period of growth.

ELIZABETH A. CLARK, M.D.

March (Fague) Fractures of the Long Bones of the Lower Extremity and Pelvis. Albert L. Leveton. *Am. J. Surg* 71: 222-232, February 1946.

The author adds 12 cases of march fracture other than metatarsal to the many recent reports. These were observed in a series of 10,953 orthopedic cases seen in an Army Station Hospital in nine months. The insidious onset and difficulties of early diagnosis are again emphasized. In the early stages the roentgen examination may be negative. Later there is commonly some periosteal thickening and the fracture tends to spread through the bone after the manner of a crack in ice. The callus increases in amount but is never excessive. In older cases a zone of increased density may be demonstrable in the area of fracture. Displacement of the fragments is unusual except in femoral neck fractures where it should be prevented by immobilization. Avoidance of early weight bearing is of importance in all cases.

Six of the fractures in the author's series involved the tibia, 3 the pelvis, 2 the femur and 1 the fibula. Complete clinical abstracts of the cases are given with excellent illustrations.

JOHN A. COCKER, M.D.

Roentgenographic Examination of the Ankle Joint in Malleolar Fractures. Thorsten Hendelberg. *Acta radiol* 27: 23-42, Jan 31 1946. (In English.)

In order to evaluate the mechanism of production of fractures and dislocations at the ankle the author per-

GYNECOLOGY AND OBSTETRICS

formed experiments on autopsy material, observed fresh fractures by means of fluoroscopy and arthrography, and made a survey of a ten year series of such fractures. On manipulation of fresh fractures under local anesthesia, a definite dislocation tendency was observed fluoroscopically in 28 of 42 cases and in some ligamentous injuries could be demonstrated. With the knowledge of the mechanism of fracture thus obtained, the author believes more exact reduction can be accomplished.

The accuracy of fluoroscopy in the detection of injuries to the ligaments was investigated by means of arthrography. In 15 of 16 cases in which no dislocation tendency was observed or in which the fractured malleolus accompanied the talus in dislocation, no contrast medium was observed outside the joint space. Conversely, in 9 of 10 cases in which a dislocation tendency could be demonstrated fluoroscopically, contrast medium was observed outside the joint space. The results of the two methods are thus in good agreement, but the author stresses that the validity of results from arthrography for capsular injury is lost if the examination is not made within 24 hours following trauma, because of coagulation of blood at the site of injury.

By means of a wooden wedge driven between the tibia and fibula anteriorly, injury to the anterior tibiofibular ligament was reproduced, and it was found that no widening of the space can be demonstrated in routine roentgenograms although changes can be observed by fluoroscopy and by arthrography. Also fractures of the posterior tibial surface were produced in autopsy specimens, and roentgenograms were made in the two routine positions. It was found that this limited study was inadequate to visualize the fracture line to estimate the size of the fragment or to ascertain the extent of the injury at the articular surface, and the importance of oblique views when this type of fracture is suspected is emphasized.

ELIZABETH A. CLARK, M.D.

Roentgenologic Skeletal Changes in Myeloma in Childhood (Platypondylia generalisata myelomatosa)
Gösta Jansson. *Acta radiol* 27 73-80, Jan 31, 1948
(In English.)

Only 8 cases of multiple myeloma in children are said to have been reported up to 1939. The author presents a case in a 9-year-old boy whose chief complaints were recurrent fever and extreme back pain. Progressive anemia occurred until a few days before death, the hemoglobin was 14 per cent. Roentgenologically the bones of the pelvis, upper femora, the knees and the shoulder joints revealed multiple cystic appearing areas of bone destruction. There were generalized decalcification and a marked platyspondylitis throughout the spine. The roentgenographic appearance could not be differentiated from that of Schüller-Christian's disease, and the diagnosis was not made until autopsy was performed. Even had a premortem diagnosis been made, the course would probably have been unchanged as myeloma is rapidly fatal in the young and there is no effective treatment.

In other reported cases there has been variation in the extent of the bony lesions but involvement of the vertebrae and punched-out lesions elsewhere are characteristic. Severe progressive anemia occurred in the cases in which blood studies were reported. Renal calcification was described in two cases.

ELIZABETH A. CLARK, M.D.

Artificial Pneumoperitoneum by Cul-de-Sac Puncture: A New Technic for Pelvic Pneumograms
Albert Decker. *New York State J Med* 46 314-317, Feb 1, 1946

The introduction into the abdomen of air, carbon dioxide, or oxygen, under pressure, has long been used as a diagnostic procedure. As an aid in roentgen examination it was perfected some twenty five years ago, but it has never been extensively employed. Stein, on the basis of a large experience, states that pneumograms are more informative and less harmful in some cases than hysterosalpingography. He has combined the two procedures in selected cases with excellent results. In general carbon dioxide has been the medium of choice and the transuterine route has been preferred to the transabdominal.

Recently, experience with the production of pneumoperitoneum in conjunction with "culdoscopy" (Decker and Cherry *Am J Surg* 40 44, 1944) has suggested a new, safe, and simple technic for the introduction of air or carbon dioxide into the peritoneal cavity. It utilizes the negative pressure created in the abdomen with the patient in the knee-chest position. A short, beveled 4 1/2-inch needle, 20 gauge, attached to a 2-c.c. syringe, is pressed against the posterior vaginal wall at a point just above the cervix. The needle point is directed toward the center of the pelvis and pushed through the vaginal vault into the cul-de-sac. When the plunger of the syringe is removed an immediate and spontaneous pneumoperitoneum results. The rush of air can be attested by the sound created in the syringe by alternately opening and closing the aperture with the thumb. When it is desired to substitute carbon dioxide for air, a special cannula can be used. Carbon dioxide has the advantage of quick absorption but when pneumograms are to be taken several hours after the introduction of gas it is advisable to use air to insure continuation of the pneumoperitoneum.

The advantages of this new technic are as follows: (1) the psychic aversion to abdominal puncture is avoided, (2) the air is not introduced under pressure, so that the danger of air embolism is avoided, (3) the pelvis is notoriously less readily infected than the abdomen, (4) very little apparatus is needed and no local anesthesia is required, (5) danger of injury to the intestine is minimized, as the position removes them from the pelvis, (6) when the special cannula is used for the production of transvaginal pneumoperitoneum the pelvis is available for endoscopic examination (culdoscopy).

The author presents one case in detail, illustrating the value of this procedure in the diagnosis of a pelvic tumor.

BERNARD S. KALAYJIAN, M.D.

Radiologic Diagnosis of Ectopic Pregnancy Richard H. Marshak. *New York State J Med* 46 317-318, Feb 1, 1946

The author records a case in which uterosalpingography was performed to determine the cause of uterine bleeding and an ectopic gestation was accidentally discovered. Two films were taken, one with 2 c.c. of viscorayopaque and the next with 4 c.c. These showed a normal uterine cavity and a normal right tube. In the mid portion of the left tube was a circular defect about 1.5 cm. in diameter. A diagnosis of left tubal pregnancy was made and confirmed by exploration.

which also showed a small localized hematocele in the cul-de-sac. Although an ectopic pregnancy had been suspected in this case laboratory findings, including a Friedman test, were so completely negative that laparotomy had been postponed.

The author raises the question as to the advisability of doing uterosalpingography more routinely to aid in the diagnosis of ectopic pregnancy. This diagnosis in unruptured cases or in cases in which there has been a pin point rupture with a localized hematocele may be very difficult. Also it is not unusual to explore a patient and find no abnormality in the tube. It is in the type of case described in this article that no harm can accrue from salpingography if it is performed under proper circumstances. In the presence of a positive pregnancy test, the procedure is, of course, contraindicated unless a viable intrauterine fetus is excluded. It is not necessary to use more than 4 c.c. of the opaque medium to visualize the tube, and thus should be injected slowly, preferably under fluoroscopic control. The author believes that if there are no ill effects from salpingography, it may prove to be preferable to any type of operative procedure. If, on the other hand, further experience with more cases reveals that there is a danger, incision in the cul-de-sac is unquestionably more advantageous. **BERNARD S. KALAYJIAN, M.D.**

THE GENITO-URINARY SYSTEM

Percutaneous Puncture of Renal Cysts and Tumors. Knut Lindblom. *Acta radiol.* 27: 66-72, Jan 31, 1946. (In English.)

The occurrence of renal tumors and of solitary cysts in elderly persons is not infrequently a diagnostic problem, and surgical exploration in the older age group is associated with increased risk. The author suggests, therefore, percutaneous puncture of the renal mass with injection of diodrast as a diagnostic procedure. In the 6 reported cases, localization was carried out under fluoroscopic observation, and the diagnosis of solitary cyst was made in five cases and of hypernephroma in the sixth. Complications included dull pain at the site of injection in 3 cases and mild febrile reaction in another.

ELIZABETH A. CLARK, M.D.

THE BLOOD VESSELS

Early Diagnosis of Phlebothrombosis. William R. Moses. *New England J. Med.* 234: 288-291, Feb 23, 1946.

The high incidence of phlebothrombosis of the leg veins, with its lethal potentialities, is discussed. Considerable stress is placed on the early diagnosis of bland venous thrombi so that measures for the prevention of pulmonary embolism may be instituted. In the author's experience venography is of extremely limited value in the early diagnosis of phlebothrombosis of the calf veins. Homan's test is also thought to involve certain unavoidable fallacies resulting in a dangerously large number of false-positive and negative responses. A clinical test for the differentiation of early phlebothrombosis and the lesions simulating it is described, and the results are outlined.

Phlebography: Anatomical, Physiopathological, and Clinical Considerations. Luigi Imperati. *Arch. di radiol. (Naples)* 17: 421-440, November-December 1941.

The author illustrates by presenting seventeen phlebograms, some of the uses of phlebography in the differential diagnosis of various lesions involving the veins and in obtaining data about their anatomy and physiology. He used both uroselectan B and perabrodil as opaque media. **E. T. LEDDY, M.D.**

TECHNIC

Duplication of Radiography by Solarisation. G. H. Illingworth. *Brit. J. Radiol.* 19: 66-69, February 1946.

Improved and more dependable results in copying roentgen films are obtained by a modification of the solarization method suggested by Henry, Bird, and Stauffer (*Am. J. Roentgenol.* 49: 554, 1943). Both surfaces of the film are fogged; a contact exposure is then made; the film is developed in a metol hydroquinone developer, fixed in hypo, washed, cleared in Farmer's reducer, again washed, and dried.

SYDNEY J. HAWLEY, M.D.

RADIOTHERAPY

NEOPLASMS

Evaluation of the Treatment of Cancer of the Breast, with a Suggestion for Its Modification. Charles Stanley White. *Am. J. Surg.* 71: 205-209, February 1946.

The author feels that in the treatment of cancer of the breast we are at a place "where the prospects of reducing the early mortality or extending the span of life seems to have reached an impasse, unless we can better apply the tools at our disposal." He emphasizes the importance of adequate pathologic examination for diagnosis. Punch biopsy he considers of little value, only when positive for cancer can it be given any consideration. Again, metastatic deposits in the regional lymph nodes can be diagnosed only by the pathologist. They must be searched for carefully. Palpation will not differentiate the neoplastic from the inflamed node. The value of pathologic examination is commensurate with the adequacy of surgical excision, the diligence with which the excised tissue is examined, and the pains with which microscopic studies are done.

Radiation and surgery are the only available means of combating carcinoma of the breast, but it is questionable whether we have exhausted their possibilities, particularly as a dual method of attack. The author believes that concentrated preoperative irradiation should be given for two or three days, followed by surgery in four or five days.

Since it has been found possible to obtain a two-year arrest of the malignant process by irradiation, the author suggests the advisability of giving periodic courses of irradiation spaced at two- or three-year intervals, believing that thereby feeble cancer cells which have become activated after a single series of treatments may be attenuated and eventually destroyed. He is putting this regimen into effect in cases of apparent cure and hopes in five years to have enough data on the method to encourage further studies or to warrant abandonment of the principle of surgery plus periodic irradiation.

ARTHUR W. FRYDE, M.D.

Roentgen Treatment of Carcinoma of the Breast. Carlo Guarini Arch di radiol (Naples) 17 189-317, May-June and July-August 1941

After an exhaustive review of the world's literature on the subject (the bibliography of this paper covers seven pages), Guarini presents his own experience with roentgen therapy for carcinoma of the breast based on 750 cases from his private practice and from the Istituto Foto-radio-terapico in Naples. None of his cases fell in Stenhal's group I. Of 47 patients in group II (Stenhal), 19 were living and well after five years, and of 181 patients in group III 17 were living and well after five years.

Guarini has treated 138 recurrent cases, of which 60 were controlled for five years, 337 cases treated post-operatively gave a five year survival of 227. Incidentally he advises routine sterilization of the ovaries by x rays. E T LEBBY, M D

Radiation Treatment of Carcinoma of the Female Urethra. James Jackman and Ralph D Bacon Pennsylvania M J 49 518-519, February 1946

The technic used in the treatment of carcinoma of the urethra the complications encountered and the preliminary results in the treatment of 8 cases are described in this article.

Inspection of the urethra usually reveals an area of tumefaction around the external meatus, and gross differentiation from caruncle is often impossible. Diagnosis must depend on histological examination.

Radiation is given through a cone 2 to 4 cm in diameter, placed directly against the external meatus, 300 r (in air) being given daily for five or six days (200 kv, 15 ma, 50 cm distance Thoraeus filter). This is followed immediately by the insertion around the urethra of three or four 10-mg needles of radium having a filter equivalent to 0.5 mm of platinum, for a gamma roentgen dose of 3,000 to 4,000. The combined dosage from both x rays and radium is about 7 tissue erythema doses.

Radiation beyond this amount is not well tolerated and may cause extreme discomfort. A urethral stricture may develop which will necessitate monthly dilatations. For local recurrence further cauterization and local radium therapy is used.

Of the 8 patients treated 5 (possibly 6) are free of the disease for a few months to five years after preliminary treatment. There has been one death and one recurrence. All the cases were diagnosed histologically as squamous carcinoma.

JOSEPH T DANZER, M D

Obscure Lymphosarcoma. Howard A Ball California & West Med 64 82-83, February 1946

A woman 53 years of age had generalized discrete lymphadenopathy a palpable tender spleen moderately enlarged lymph nodes and a white blood count of 10,150 with 64 per cent lymphocytes which would be equivalent to about 6,500 lymphocytes per cubic millimeter. An inguinal node was removed for study and the microscopic findings were reported as compatible with leukemic lymphadenosis but not warranting a diagnosis of lymphosarcoma.

X-ray therapy was given to the spleen, both sides of the neck, both axillae and both groins, in a system of rotation. Five days after 100 r had been delivered over the spleen the circulating lymphocytes had dropped to 1,600 per cubic millimeter. Four days later this figure had increased to 3,500.

During the next four months, a total of 1,500 r of x-ray therapy was given, 300 r over the spleen. At four and a half months, a reversal in the differential count occurred. While nine counts in the initial period had shown an average of 60 per cent of the circulating white blood cells to be lymphocytes, fourteen counts during the next year and a half averaged only 33 per cent lymphocytes. Over a year after this the patient was again seen with bleeding from the nose, anorexia, weakness, loss of weight, and migrating skeletal pains. The spleen and a few small lymph nodes were palpable, and the white blood count showed a total of only 2,000 cells per cubic millimeter with 68 per cent lymphocytes. Death occurred three weeks later, and autopsy showed scattered foci of neoplasm along the spine, ribs, celiac axis, and in the hilus of the spleen. The spleen and liver were moderately enlarged and the kidney parenchyma was infiltrated with tumor. Both the femoral and sternal bone marrow were almost white with neoplastic involvement. The final diagnosis was lymphosarcoma.

The author concludes that in such cases, the areas of most extensive involvement as seen at autopsy are for the most part those not subjected to radiation therapy and asks whether, in a case of systemic lymphadenopathy that responds well to external radiation, we should not 'also include treatment to the visceral gland bearing areas lying chiefly along the mid-line of the thorax and abdomen, even in the absence of symptoms referable to them'.

BERNARD S KALAYJIAN, M D

Radioactive Phosphorus as a Therapeutic Agent. A Review of the Literature and Analysis of the Results of Treatment of 155 Patients with Various Blood Dyscrasias, Lymphomas, and Other Malignant Neoplastic Diseases. Edward H Reinhard, Carl V Moore, Olga S Bierbaum, and Sherwood Moore with Appendix by Martin Kamen. J Lab & Clin Med 31 107-218, February 1946.

This article of over 100 pages (1) reviews in detail the literature covering the use of radioactive phosphorus, (2) summarizes the experimental work which provided the rationale for the therapeutic use of that isotope, (3) describes the authors' own experience during the last four years in 155 cases of hematologic dyscrasias or malignant neoplastic diseases, (4) evaluates the effectiveness of this agent as compared with older methods of treatment.

Thirty patients with *polycythemia vera* were treated with eminently satisfactory results. The symptoms disappeared and the red blood counts returned to normal after a latent period. The dosage of P^{32} must be individualized, as it is impossible to predict how much therapy any given patient will require for a satisfactory response. No other method yet used has produced comparable results but whether or not life is prolonged remains to be seen. Detailed case reports and tabulated summaries lend emphasis to the more general statements made in the discussion.

Myelogenous leukemia was treated in 39 unselected patients. Here again treatment must be highly individualized always with an attempt to keep the blood count as nearly normal as possible. The results in this group of cases are summarized as follows: (1) P^{32} has not succeeded in curing any patient, (2) P^{32} has very little effect on the course of acute or subacute myelogenous leukemia, (3) P^{32} produces clinical and hematologic remissions roughly comparable to those induced

by roentgen radiation and Fowler's solution in nearly all subjects with the chronic form of the disease. The main advantages of P^{32} over roentgen rays are the absence of radiation sickness and the more constant irradiation effect, which is thought to keep the blood count on a more even keel. The principal toxic effects to be avoided are leukopenia, thrombocytopenia, and aplastic anemia. In an occasional case relief of joint or deep bone pain or reduction in size of lymph nodes which may be causing pressure symptoms may not be as complete with radioactive phosphorus as with x-ray. It is, of course too early to determine whether prolongation of life is produced by this method of therapy. A treatment schedule is furnished, and detailed case histories and tabulated summaries give valuable emphasis to the generalizations made in the discussion.

Forty five unselected cases of *lymphatic leukemia* were treated. In the chronic and subacute forms the history of symptoms is usually shorter than in myelogenous leukemia. In general in these cases the treatment with P^{32} was highly beneficial, with alleviation of symptoms and even most of the signs of the disease. Tables on the complete series and detailed histories of two cases which responded in a typical fashion are given.

Fifteen patients with *leukosarcoma* or acute lymphatic leukemia were treated but all died. Comparison with x-ray irradiation showed that P^{32} was no more effective in relieving symptoms. The hematologic remissions were similar to those produced with external irradiation but reduction in localized adenopathy and splenomegaly was not quite as successful as with external irradiation. There is no indication that P^{32} is likely to prolong life more than does x-ray.

Monocytic leukemia was treated with P^{32} in 10 patients. The results were uniformly disappointing.

Hodgkin's disease was treated in 6 patients and P^{32} was found to be inferior to x-radiation.

A group of 5 patients with *lymphosarcoma reticulocell sarcoma* or *giant follicular lymphoblastoma* were treated. It is the authors impression that roentgen irradiation is more effective and less dangerous than P^{32} for this group of diseases.

Multiple myeloma was treated in 8 patients but P^{32} did not prove to be a valuable therapeutic agent. It was the authors impression that the treatment significantly shortened the duration of life in two patients by producing severe leukopenia and thrombocytopenia.

Three patients with *Ewing's sarcoma*, 1 with *malignant melanoma*, 1 with *anaplastic carcinoma*, 2 with *mycosis fungoides* and 1 with *xanthomatosis* were treated but the results were not regarded as satisfactory.

The main article is followed by an appendix by Martin A. Kamen on the assaying of radioactive phosphorus. Investigation as to the best method of assay is being carried on.

SYDNEY F. THOMAS, M.D.

A Study of the Distribution of Radioactive Phosphorus in Three Cases of Cancer. Arne Forssberg. Acta radiol. 27: 88-92, Jan 31 1946. (In English.)

One case of hypernephroma with metastases to bone and skin and two cases of carcinoma of the breast with

widespread metastases were treated with radioactive phosphorus, and the tissues were analyzed quantitatively after death, the values obtained being corrected for decay back to the time of death. The findings agree with those of other workers and with the previous work of the author on experimental animals (Acta radiol. 26: 523, 1945). Abst. in Radiology 47: 550, 1946. In that organs of higher metabolic rate were found to contain larger quantities of P^{32} . Likewise, tumor tissue in the organs of high metabolic rate, i.e., liver, kidney and spleen, did not contain more P^{32} than the normal portion of the same organ. In each of the three cases the tumor tissue in bone contained appreciably more P^{32} than corresponding normal bone, although values did not exceed those for the organs of high metabolic rate. Similarly an increase over the amount in corresponding normal tissue was found in skin metastases in one case and in involved mammary tissue in another. The author's observations suggest to him the possibility of treatment of bone metastases by P^{32} but the effect of the high concentrations of the isotope upon the blood-forming elements requires further investigation before any conclusion on this point can be reached.

ELIZABETH A. CLARK, M.D.

NON-NEOPLASTIC DISEASE

The Struggle with Tinea. Combined Treatment with Roentgen Rays and Thallium. Silvio Parenti. Arch. di radiol. (Naples) 17: 460-480, November-December 1941.

The author has treated with x-rays and thallium acetate 146 cases of tinea with satisfactory results. He also presents a detailed discussion of ringworm and methods of treating it, and adds an extensive bibliography.

E. T. LEDDY, M.D.

Physical Therapy of Sinusitis by the Combined Action of Radiations. Giuseppe Muscettola. Arch. di radiol. (Naples) 17: 318-337, July-August 1941.

The author treats sinusitis with roentgen rays (125-150 kv and 2-3 ma) in doses of not more than 75 r, seldom given more than four times at four to six-day intervals with good results. No statistics are given. Both acute and chronic sinusitis receive short wave and infra red therapy in addition.

E. T. LEDDY, M.D.

Roentgen Therapy for Varicose Ulcer. Aldo Piergrossi. Arch. di radiol. (Naples) 17: 357-370, September-October 1941.

A group of 4 cases of varicose ulcer was treated by local irradiation. A second group of 6 was treated by irradiation of Scarpa's triangle, a third of 10 cases by irradiation of the contralateral lumbar spine, and a fourth group of 5 cases by lumbar homolateral irradiation. The immediate benefit was striking but the result in all cases was only temporary. The author regards the effect produced as due to an influence on the sympathetic system. The method could be used in conjunction with the surgical treatment of the lesion.

E. T. LEDDY, M.D.

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Observations on the Etiology and Frequency of Spondylolisthesis and Its Precursors¹

WILBUR BAILEY, M D

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IN LESS THAN twenty years the concept of spondylolisthesis has changed so that its occurrence is now considered fairly frequent, rather than being looked upon as a rarity. Furthermore, there is now general agreement that the term "spondylolisthesis" should be limited to those cases in which forward displacement of the vertebral body has occurred accompanied by bone defects consisting of a solution of continuity in the isthmus, or partes interartulares, of the involved vertebrae. When such defects are present without accompanying ventral displacement of the vertebral body, the term "prespondylolisthesis," "spondylolysis," "spondylolysis" or, perhaps most logically, as suggested by Lerner and Gazin (14), "interarticular isthmus hiatus," is used.

The studies to be reported here have been limited to developing further information on the following subjects:

1 The genesis and frequency of vertebral isthmus defects with a discussion as to whether such defects are congenital or traumatic in origin. Cases of hereditary transmission are presented.

2 The frequency of occurrence of spondylolisthesis and its precursors. Some 2,080 unselected young men—candidates for the Armed Forces—were given routine

lateral x-ray examinations of the lumbosacral spine to obtain this information.

3 An analysis of these cases to determine how many individuals with such defects actually have low-back pain.

4 Useful clinical signs by means of which spondylolisthesis or its precursors can frequently be detected.

ETIOLOGY

Just as trauma is considered a cause of bone defects in other regions of the body, so it has been indicated as responsible for spondylolysis and spondylolisthesis. A consideration of the possible influence of trauma should be divided into two parts:

1 Is the interarticular isthmus hiatus of spondylolysis itself traumatic in origin?

2 When actual forward slipping has occurred, so that by definition true spondylolisthesis is present, has the separation of the defect been occasioned by trauma, or will trauma be likely to produce symptoms in patients who already have such defects?

Whether the defect in the vertebral isthmus is traumatic or congenital in origin has been the subject of considerable debate. Contrary to some of the older concepts in this country, there is now a general agreement by the proponents of

¹ Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill. Nov 9-10 1945.



Fig 1 Case I (Daughter) Moderate spondylolisthesis with typical isthmus defect No symptoms

the traumatic theory of etiology that such trauma must have occurred very early in life Hitchcock (12) calls attention to the likelihood of hyperflexion during the birth process as a cause By hyperflexion of the spine, often of moderate degree and with little force, he has been able readily to fracture the neural arch in the lower lumbar region in fetuses and stillborn children

It may seem strange, in the face of evidence to be later considered, that some conscientious investigators who have made numerous thorough examinations of fetuses and stillborn children still give credence to the traumatic theory of origin The reason for their belief lies in the fact that no one has ever been able to find a failure of development in the neural arch, not subject to objection, in the material examined Since the incidence of the defect is about 5 per cent, as will be explained later, it might be expected that in several hundred examinations of fetuses and stillborn children the condition would be found at least once However, except for

Batts (3), who described an accessory center of ossification in the neural arch of the third lumbar vertebra of a fetal spine, no other authors have given authentic descriptions of such an accessory center

On the contrary, a single center of ossification appears early in each neural arch It is true that this ossification center is formed in the region which later becomes the pars interarticularis and that this region is a zone of potential weakness because of the presence of slow ossification and numerous nutrient blood vessels (Willis, 19, 20)

The development of two centers of ossification for the neural arch, though not well proved, continues to be as attractive as Willis (19) believed it in 1931, for such a hypothesis—even though it may not be established to the satisfaction of all investigators—would adequately explain later appearances on the basis of failure of fusion of such anomalous centers Failure of fusion of other ossification centers of the vertebrae, both of primary and secondary types, is common enough (Bailey, 1, 2)

In summary, therefore, it must be admitted that the evidence in favor of the traumatic theory is based upon the idea that fractures in this region can be produced experimentally in the newborn (Hitchcock, 12), and upon the purely negative finding that neural arch defects of the type which would be expected to develop into spondylolisthesis have not been discovered in fetal and newborn material in several hundred examinations, with a possible single exception (Batts, 3)

On the contrary, when the genesis of such defects is considered to be congenital, the amount of favorable evidence becomes enormous

1 These defects may involve more than one segment Friberg (7) reports very clear-cut involvement of all segments from the twelfth thoracic to the fourth lumbar, inclusive, and numerous cases in which two segments have been involved are reported (5, 15, 19)

2 There is general agreement that about 25 per cent of these defects are uni-

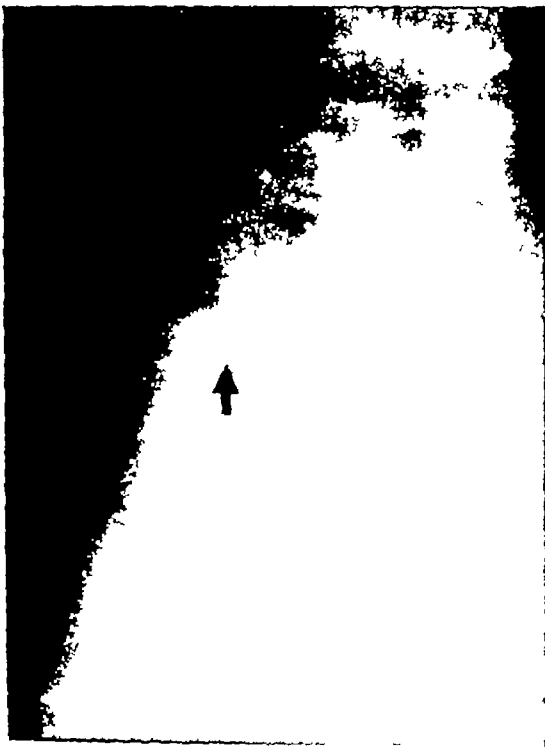


Fig 2 Case II (Father) Moderately advanced spondylolisthesis with typical isthmus defect. Absence of intervertebral disk, reactive bone changes in adjacent vertebral bodies



Fig 3 Case III (Grandmother) Isthmi of fifth lumbar vertebra very thin but apparently continuous. Lumbosacral intervertebral disk space almost absent with reactive hypertrophic bone fringes

lateral. We are inclined to agree with Garland (8), however, that closer inspection with oblique views reveals only about 5 per cent of unilaterality. In any event, the occurrence of unilaterality favors the developmental theory of origin.

3 The frequency in various widely different races is nearly the same. In 1,520 skeletons examined (Wilks, 19), the incidence was 5.2 per cent. Shore (17) reported an incidence of 6.09 per cent in 82 skeletons of Bantu natives in South Africa. Congdon (6) discovered an incidence of 5 per cent in the skeletons of 200 American aborigines. In summary, these series, widely scattered in both time and space, showed neural arch defects in 5.2 per cent of 1,802 individuals.

4 Numerous cases of spondylolisthesis or spondylolysis have been reported in children in recent years. Kleinberg (13) recorded a case of well defined spondylolisthesis in a child of nineteen months. Since this child had never walked because

of other developmental anomalies (bilateral congenital hip dislocation), it was self-evident that trauma could not have been a factor.

5 While it is true that normally a separate single ossification center is usually present for the lateral vertebral arch, it is entirely possible that on occasion two bone nuclei are laid down in this region, with subsequent failure of fusion. Similar examples, such as bipartite patellae, occur elsewhere in the body.

6 Heredity plays a definite role. In this study, three cases of hereditary transmission are added to the one case already described in the American literature, by George (9).

CASE I R M B (the daughter), student, age 18. Despite typical isthmus defects and actual mild spondylolisthesis, this young woman has no complaints, the lesion having been an incidental finding. The patient's hobby is horseback riding, which causes no low back pain (Fig 1).

CASE II M J B (the father), orthopedic appliance manufacturer, age 45. Two years before

spondylolisthesis was discovered, the patient fell from a horse, landing on his buttocks. No x-ray studies were made at that time. Symptoms of back pain persisted for only two days. Spondylolisthesis was an incidental discovery two years later. For years since, this man has ridden spirited horses without provoking low back pain. This case illustrates that moderately advanced spondylolisthesis is not necessarily disabling (Fig 2).

CASE III S B (the grandmother), orthopedic appliance fitter, age 66. This patient has not had any complaints of low back pain except for a period of several weeks twenty-five years ago. Despite the absence of the lumbosacral disk and resultant localized hypertrophic changes, frequent horseback riding has never provoked symptoms (Fig 3).

In the European literature four families have been mentioned (Glorieux and Roederer, 10), by various authors, in which spondylolisthesis or spondylolysis was found in parents and their children. It remained for Sten Friberg (7) to make a monumental report covering three generations of a family consisting of 65 individuals. Sixty-one of these 65 relatives were examined, starting with a spondylolisthetic grandfather. Of this number, 15 showed spondylolytic changes.

An interesting sidelight in this series was that of the 16 patients seen (including a spondylolisthetic man who married into the family), all were engaged in heavy manual labor, yet only 3 had any symptoms of low back pain.

OCCURRENCE WITHOUT SYMPTOMS

Because of this frequent occurrence of spondylolisthesis or spondylolysis without symptoms, it was proposed to carry the investigation further by examining a large group of supposedly normal persons—mostly candidates for the Armed Forces and selected without reference to history or symptoms. Lateral lumbosacral roentgenograms were taken on 2,080 individuals. In this series 44 per cent were found to show spondylolisthesis or spondylolysis, but only 0.5 per cent complained of any previous or present low back pain.

Early in the series it became apparent that attempts to separate those who had actual forward slipping of the vertebra

from those who merely had spondylolysis defects would not yield entirely accurate results, for special lateral x-ray examinations made in maximum extension and maximum flexion, or in the supine and later the erect position, showed in about 18 per cent of the cases at least a few millimeters of forward movement of the involved vertebral body. The following case is typical.

CASE IV W S, an 18 year old college youth, son of a radiologist, had never had symptoms of low back pain despite rather strenuous programs of athletics. His sole physical finding was prominence of the spinous process of the fifth lumbar vertebra. X-ray examination revealed a well marked lysis of the vertebral isthmus. A lateral film made in flexion showed 9.0 mm of forward displacement of the fifth lumbar vertebral body (Fig 4), while a film made in extension showed only 7.0 mm. of forward displacement of the same vertebral body (Fig 5).

A USEFUL CLINICAL SIGN

Persons with advanced spondylolisthesis may show a typical clinical sign (Fig 6). There is an offset of the spine which can be distinguished by a dimple or groove above the involved vertebra. There is also an undue prominence of the spinous process of the involved vertebra. Such signs are to be expected in advanced cases. Indeed, in the presence of lysis of the neural arch there is no reason why the posterior half of the vertebra should not migrate somewhat dorsally at the same time the vertebral body is migrating ventrally.

From the standpoint of logic alone, however, when only a simple lysis is present, prominence of the involved vertebral spinous process with a concavity above it might not be expected. Hall (11), working with some of the same material used in this study, noted, however, that simple lysis could often be detected in ordinary physical examinations by three signs.

1. An undue amount of flexion of the spine was detectable.

2. With full flexion, an unduly prominent lumbar spinous process (usually the fifth) might be detected, which would be tender to palpation.



Figs 4 and 5 Case IV Fig 4 is a lateral film *in flexion*, showing 9 mm forward displacement of the fifth lumbar vertebral body. A depression in the cranial surface of the sacrum indicates that forward displacement, though symptomless is of long standing. Fig 5, a lateral film made *in extension* shows 7 mm of forward displacement of the fifth lumbar vertebral body.

3 Such a spinous process might be more mobile than normal.

In an effort to refer for x-ray studies only those individuals in whom a neural arch defect was present, the above clinical signs were used in 2,080 cases. As a result, the number of cases in which positive findings were present rose from the usual 4.4 per cent on unselected material to between 29 and 50 per cent, depending upon the experience of the clinician. The signs are simple and seem well worth using, therefore, when large groups are being examined.

COMMENT

Since an average of one individual in twenty shows isthmus defects in careful x-ray examinations, and, in many, actual forward motion of the vertebral body can be demonstrated by special technics, the question arises whether such men can be useful for vigorous physical effort such as military service or heavy manual labor.

Hitchcock (12) has followed four cases of spondylolisthesis in which progressive increase in forward slipping over a period of years has been demonstrable.

As already noted, congenital isthmus defects are frequently present without the patient being aware of them. The trend is recently more and more to regard such defects as being in the same category as fully sacralized fifth lumbar vertebrae, lumbar ribs, spina bifida occulta, etc. As Bohart (4) pointed out, such developmental anomalies did not prove a source of symptoms in a large series of men he examined, who were frequently subjected to severe trauma.

We should probably not be too ready to indict isthmus defects as a cause of symptoms. It is undoubtedly true that patients with spondylolysis and spondylolisthesis sometimes have low back pain. So do others. Meyerding (16) suggests intervertebral disk displacement rather

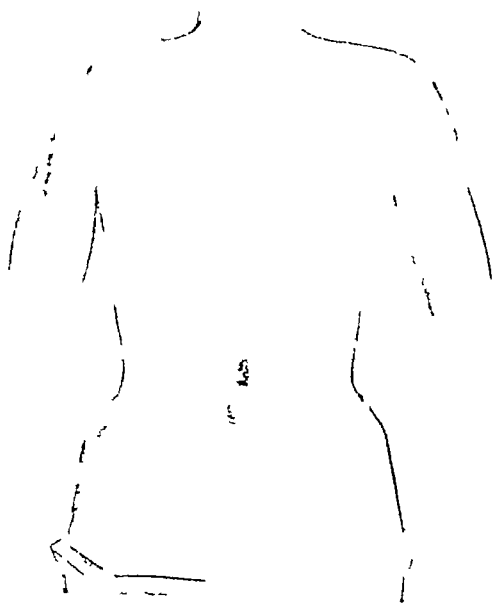


Fig 6 A characteristic dimple or groove is often present above the spondylolisthetic vertebra. The spinous process of the involved vertebra is sometimes unusually prominent

than the movement of the vertebral body as a cause of this pain. Whatever the cause actually may be, it is well to bear in mind that many individuals with well advanced lesions are symptom-free or nearly so. The family previously discussed as showing hereditary transmission (Figs 1-3) was typical, in that the patients, in spite of moderately advanced lesions, had little or no back pain.

SUMMARY

1 About 5 per cent of people of all races show vertebral isthmus defects. Accumulated evidence seems definitely to indicate that such defects are congenital in origin.

2 Hereditary transmission occurs, as is shown by cases presented here.

3 Among 2,080 lateral lumbosacral x-ray examinations made on unselected cases, 44 per cent showed isthmus defects. Only 0.5 per cent of these individuals had complained of low back pain. It is, therefore, often incorrect to conclude that spondylolisthesis or its precursors is in any way connected with trauma.

4 When special x-ray studies were

made with the patient erect and recumbent, or with full flexion and extension, some forward motion of the vertebral body could be demonstrated in 48 per cent of those having isthmus defects.

5 Several simple clinical signs are described, by means of which persons most likely to show defects can be selected for x-ray examination.

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Roentgen Features of Mucocele of the Appendix¹

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ALTHOUGH MORE than five hundred cases of cystic dilatation of the appendix have been recorded in the literature (19), little has appeared concerning the diagnostic aspects of the condition. Since the original description by Rokitsansky (18) in 1842, a fairly complete knowledge of the surgical and pathological features has been gathered. At the Mayo Clinic, 146 cysts were found among 43,000 appendectomies, an incidence of one in three hundred (22). It is generally accepted that the primary etiologic factor is obstruction of the lumen of the appendix, in the absence of pyogenic infection (2). Naeslund (12), in 1928, produced typical mucoceles in rabbits by simple ligature of the vermiform processes.

Clinically, the lesion varies in size from a slight localized enlargement of the appendix to a globular mass 10 cm or more in diameter (13). It is usually benign but, in the event of rupture into the peritoneal cavity, pseudomyxoma peritonei may result. Woodruff and McDonald (22), however, present evidence to support the belief that this malignant complication can arise only when the cyst is the seat of an adenocarcinoma, none of 8 benign cysts encountered with rupture having eventuated in this fashion. But, since there are no means of distinguishing the malignant from the benign forms of the disease, except by histologic study, any diagnostic method which will increase the frequency of its preoperative recognition is of more than academic importance.

Anatomically, there are certain features of the disease which should render it susceptible of roentgen diagnosis in many instances. When the cyst attains sufficient size, it will produce significant displacement and deformity of the cecum, to which it is attached. For the same reason, if the

cecum is mobile, and it usually is, the mass will move with it. Calcific deposits in the wall or substance of the cyst are of not infrequent occurrence (2, 14, 15). The closed nature of the cyst makes its lumen impermeable to contrast media administered orally or by enema, unless patency is re-established. The latter situation is known to occur, cases recognized roentgenoscopically having been reported by Vorhaus (21) in 1930 and by Lifvendahl and Ries (10) in 1932. But the frequency of such an occurrence must be insignificant, Woodruff and McDonald (22) did not report a single instance in a series of 146 cysts.

In spite of these distinctive features, most writers have been pessimistic with regard to the likelihood of a preoperative diagnosis of appendiceal mucocele (3, 4, 6, 9). Jackson (7), however, in 1936, expressed the opinion that more careful x-ray studies might prove of value in the future recognition of the condition. In the same year, Åkerlund (1) demonstrated a correlation between the roentgen and pathological findings in two cases in which the roentgenograms had been inadequately interpreted preoperatively. He pointed out that a roentgen diagnosis of this affection is possible where, "in the absence of contrast filling of the appendix, one finds a rounded, sharply outlined soft-tissue shadow in the cecal region, without any connection with adjacent parenchymatous organs, and where, within this soft-tissue shadow, one can demonstrate superficial calcium deposits which give the picture an appearance somewhat similar to the findings in cholecystitis calcificans." Jutras (8), in 1938, furnished further support to Åkerlund's opinion in a case of his own, as well as in two cases which had previously been published by a colleague (11). In July 1939, Goinard *et al*

¹ Accepted for publication in March 1945



Fig 1 Barium enema study, postero-anterior projection showing soft tissue mass with calcific central deposit adjacent to cecum

Fig 2 Right anterior oblique projection showing anteromedial displacement of cecum

(5), apparently unaware of previous radiological publications, presented a case with characteristic roentgen features, in which the preoperative diagnosis was "benign mass." In October of the same year, Varela-Fuentes *et al* (20), of Montevideo, reported the first instance of a correct preoperative diagnosis based on Åkerlund's description. Another instance is presented herewith.

CASE REPORT

Mrs E B, a white woman aged 42, was admitted to the hospital complaining of a dull ache in the right lower quadrant of the abdomen, of ten months duration, present only when she lay supine. Her past history was negative in the sense that she had never had any serious illness or symptoms referable to this area. However, she had been troubled by constipation and heartburn during her entire adult life. About seven years prior to admission, a radiological examination of the gastro-

intestinal tract had been done at a large metropolitan clinic, but no organic disease was disclosed at that time. Menses were regular and normal. The patient had had two children, delivered spontaneously, without complications. The gynecological history was negative.

The onset of the present illness occurred insidiously, about ten months earlier, when the patient noticed a dull pain in the right lower abdomen upon lying down. The pain disappeared when any position other than supine was assumed. Occasionally, it radiated down the right leg to the knee. There were no other associated symptoms, no nausea or vomiting, no diarrhea or inordinate constipation, nor was blood or mucus present in the stools. The urine was negative. The symptoms remained essentially unchanged for ten months when, upon the advice of her family physician, the patient was hospitalized with a view to appendectomy.

On physical examination positive findings were limited to the right lower quadrant of the abdomen. Here, a smooth, round, moderately tender mass mobile in all directions, was palpable at the level of the anterior superior spine of the ilium. There was



Fig 3 Photograph of gross specimen with some of gelatinous content which leaked out during manipulation

Fig 4 Cross section of gross specimen showing central calcific deposit

no muscle spasm or rebound tenderness in this region. No other abdominal mass or viscus was palpated. There was no costovertebral tenderness. Rectovaginal examination revealed no mass within reach of the examining finger. Examination of the blood and urine disclosed no evidence of anemia, leukocytosis, hematuria, or pyuria.

The patient was referred to the radiologist with a tentative diagnosis of mucocyst of the appendix or right ovarian cyst with a long pedicle. A barium enema study (Figs 1 and 2) revealed no abnormality of the colon between the rectum and cecocolic junction. Passage of the clysmas elicited no pain or discomfort. There was moderate delay in filling of the cecum, which was displaced medially and anteriorly by a reniform, freely mobile, sharply circumscribed soft tissue mass, measuring about 6×10 cm. The lateral and posterior margins of the cecum, as well as the adjacent descending colon and terminal ileum, were grossly concave where the mass came in contact with them. Upon manual displacement, the mass maintained its relationship to the cecum, but the descending colon and ileum could be separated from it. The mucosa of the colon and ileum appeared to be intact. In the center of the mass was an irregular accumulation of material of calcific density, resembling a swastika in configuration. No stratified calcification could be distinguished. The contrast agent did not

enter the lumen of the appendix. Radiographic study confirmed these findings, except that, due to spasm of the cecum, the concave deformity was not demonstrated. A radiological diagnosis of mucocyst was made.

At operation, a retrocecal cystic mass, identified as a mucocyst of the appendix, was found. The right ovary was cystic, but otherwise normal in appearance. Both the appendix and ovary were resected. During manipulation, the mucocyst was ruptured, a small amount of blood-tinged gelatinous fluid escaping into the free peritoneal cavity.

Pathologic examination revealed (1) a mucocyst of the appendix, measuring 8.0 cm in diameter, with a dense, calcified mass in its center, and (2) a pseudomucinous cyst of the ovary, 5.0 cm in diameter (Figs 3 and 4). Chemical examination proved the content of both tumors to be pseudomucin. In order to establish the calcareous nature of the deposit, and to rule out the possibility of inspissated barium, qualitative analysis was made. This resulted in strongly positive tests for calcium, with no trace of barium.

The patient made an uneventful recovery.

DISCUSSION

A review of the literature reveals but three published cases (10, 20, 21) of muco-

cele of the appendix in which a correct diagnosis was made prior to operation or autopsy. A fourth case is described here. As early as 1915, Ogilvie (16) reported an instance of calcareous mass in the right lower quadrant of the abdomen, in which "the roentgenogram clouded the picture," the diagnosis hanging between a ureteral calculus and a calcified cyst of the appendix. Undoubtedly, had more modern methods of urological diagnosis been available to him, a correct diagnosis would have been made. Timoney (19) states that LeWald made a correct diagnosis on the basis of roentgen findings many years ago, but he does not describe them. Scrutiny of published reproductions of roentgenograms, especially those of Jutras (8), Mousseau (11), Gonnard *et al* (5) Varela-Fuentes *et al* (20), and of Ostrum and Miller (17), lead to the conclusion that Åkerlund is correct in his assumption that a roentgen diagnosis of mucocoele should be feasible in many instances.

Unquestionably, the diagnosis has usually been missed because it has not been considered. A more recent failure (17) may be attributed to lack of familiarity with the literature on the subject, for the authors in this instance fail to mention the papers of Åkerlund and Jutras, and express the unfounded belief that their case was "unique—the first case of calcified mucocoele of the appendix reported."

It is felt that while all of the criteria enumerated by Åkerlund are of value in the diagnosis of this condition, not all are essential. A sharply circumscribed globular or kidney-shaped mass, mobile but not separable from the cecum, with displacement of the latter in a medial direction, can hardly be attributed to anything other than mucocoele. Additional findings, such as failure of the appendix to fill with a contrast agent, calcification, and a vortical appearance of the cecal mucosal pattern, as described both by Vorhaus (21) and Jutras (8), simply add further support to the diagnosis. A pyogenic abscess of the appendix or peri-appendicular tissues is a firmly fixed mass. An ovarian cyst not

only is unlikely to become adherent to the cecum but, if it does, will displace it laterally rather than medially. A retroperitoneal tumor should be fairly immobile. An intrinsic tumor of the cecum does not displace it. Calculi of urinary origin are identified by urological methods.

SUMMARY

1 Little has been published concerning the diagnosis of mucocoele of the appendix. Since the appearance of Åkerlund's study (1), fairly definite roentgen criteria for accurate diagnosis have been established.

- (a) A sharply circumscribed, globular or reniform soft-tissue mass, with considerable mobility, but firmly attached to the cecum.
- (b) Medial displacement of the cecum by this mass.
- (c) Calcium deposits in the wall or substance of the mass, failure of the appendix to fill with contrast agent, and a vortical appearance of the folds of cecal mucosa support, but are not essential to the diagnosis.

2 A case in which a correct preoperative diagnosis was made, chiefly on the basis of Åkerlund's criteria, is reported.

3 Attention is invited to the importance of considering the likelihood of this disease when clinical or roentgen findings point to the right lower quadrant of the abdomen.

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Roentgen Treatment of Infections of the Tonsils and Post-Pharyngeal Lymphoid Tissues in Children¹

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THE PURPOSE of this paper is to stress the value of roentgen therapy in the treatment of infections of the tonsils and the post-pharyngeal tissues in children. The lack of material in the literature on this method of treatment indicates a failure to realize its importance.

No attempt is being made to compare results obtainable by roentgen therapy with those obtainable by other methods. Neither is it our object to show the superiority of irradiation to surgery, or *vice versa*. Any statement made concerning a patient "without tonsils or adenoids" is made with the intention of indicating that they have been removed surgically. No reflection upon surgery is intended. Tonsillar and adenoid tissue may still be present, not because of the failure of complete removal, but because of persistent infection, causing regeneration of lymphoid tissue. Crowe writes: "Adenoids recur in more than 75 per cent of the children whose tonsils and adenoids have been removed before the age of puberty. It is so common that it must be regarded as normal."

In no instance was roentgen therapy administered with the view of eradicating tonsillar or adenoid tissue. Where tonsils appeared to be reduced in size, it was felt that the reduction was due to relief of infection in the tonsil and adjacent tissues. Although many cases of apparent primary tonsillitis were seen and treated, most cases appeared to be secondary to post-pharyngeal disease.

A statistical study based on the total number of cases treated has not been made because of inability to obtain complete returns to a questionnaire. Results have been determined by questioning parents directly, when possible, and by ex-

pressions of satisfaction on the part of referring physicians. Confidence of physicians in the method is indicated by the fact that they have continued to refer patients, in increasing numbers. In most instances, responses to other forms of therapy, both medical and surgical, had been unsatisfactory, and the attending physician referred the patients for roentgen therapy. In some cases, children were referred on insistence by the parents. The number of referring physicians, including pediatricians, is indicative of the part this form of therapy is playing in our community.

INDICATIONS

Roentgen therapy to the pharyngeal tissues was first used only in cases in which tonsils and adenoids had been removed surgically. The symptoms which had led to operation either persisted or recurred after a short period of relief. These symptoms included recurrent or persistent colds, with or without cough, varying degrees of colored nasal and post-nasal drainage, recurrent sore throat, usually preceded by a cold. In some instances discharge from the ears, decreased acuity of hearing, or even deafness was noted. Examination of the nose and throat showed evidence of chronic infection. There was swelling of the membrane of the nasal cavity, with mucopurulent or purulent discharge. The pharynx usually contained granulation tissue or what appeared to be hypertrophied tissue, probably lymphoid. Injection and redness of the pharynx and tonsillar pillars were the rule. Either the tonsils were absent or some tonsillar tissue was present, due to recurrence or incomplete removal. Con-

¹ From the Department of Radiology, Wichita and St. Joseph's Hospitals, Wichita, Kansas. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

siderable mucopurulent post-nasal discharge was evident. When roentgen therapy was administered to the nasopharynx and cervical regions of these patients, the response was remarkable and the symptoms disappeared rapidly.

Because of the satisfactory response to irradiation in cases previously treated surgically, children with similar symptoms, who had not been subjected to tonsillectomy and adenoidectomy, were also given roentgen therapy. The results proved equally satisfactory and even more spectacular because this was the sole method of treatment. Now the number of patients referred for treatment with tonsils and adenoids still present exceeds the number without tonsils and adenoids, 10 to 1.

In almost all patients, there is a history of recurrent or persistent colds. The chief complaint, however, may differ. Because the chief complaint is so definite, we have classified the cases into seven groups on that basis: (1) cough, (2) tonsillitis and sore throat with or without cervical adenitis, (3) gagging and vomiting, (4) mouth breathing, with nasal obstruction, (5) ear disturbance—recurrent or persistent draining ears with or without hearing difficulty, (6) asthma, (7) any combination of the above. No distinction is made in these groups as to whether tonsils and adenoids are present or absent. The symptoms are not necessarily attributable to their presence *per se*.

Of the patients in whom cough was predominant, many had had the tonsils and adenoids removed with the assurance that the cough would disappear. In most cases the cough diminished or disappeared entirely after one x-ray treatment. In a few instances cough was increased after the first treatment only to improve or disappear after the second treatment. This is not easily explained except to say that increased nasal and post-nasal drainage was noted after the first treatment and may have prompted an increase in the cough. In only a few cases did cough persist after three treatments. In those

instances, it entirely abated as a chief complaint by the end of the treatment series. The presence or absence of tonsils did not affect the result.

The relief of cough is probably due to a decrease in the swelling of the pharyngeal tissues together with an ultimate decrease in the drainage, which must be a factor in inciting the cough reflex. This does not fully explain the response, however, since in many instances post-nasal drainage is not present when the patient is first seen. Relief of cough may be explained on another basis, namely, a chemical change in the nasal secretion or drainage. This is merely a conjecture but should be considered in further studies. A similar relief of cough has been observed in adults in whom sinusitis existed with pharyngeal granulations, injection, and post-nasal drainage. Here, chest therapy is most essential and higher dosages are given because a bronchitis is invariably present. If irradiation were used only for the intractable cough due to upper respiratory infection, the method could be said to hold a respected place in the field of therapy.

In the group complaining chiefly of recurrent tonsillitis and sore throat, with or without cervical adenitis, the response is only second to that shown in the cough group. Here again the presence or absence of tonsils and adenoids does not change the results.

Because the tonsillitis and sore throat were preceded by colds, either recurrent or persistent, it is felt that in most instances the tonsillitis is to be regarded as a secondary manifestation. Relief of the pharyngeal and nasal condition produces relief of the tonsillitis and the throat symptoms. Similarly, in adults, where tonsils have been removed, treatment of the sinuses and pharyngeal area has a favorable effect. Pain and soreness in tags in the tonsillar floor are always relieved, thus making unnecessary further surgical removal.

In the group in which gagging and vomiting prevail, the pharynx is swollen and red. Consequently the pharyngeal space

shows a marked reduction in size. Gagging and vomiting are probably a reflex manifestation, due to a partially obstructed passageway.

Mouth breathing and nasal obstruction are disturbing but usually of not too great significance. In very young children and infants, however, irradiation has been most successful in bringing about rapid amelioration of such symptoms, forestalling surgical removal of adenoid tissue. Our records show numerous cases that were treated three to six years ago with no recurrence of the obstructive symptoms. Here again, it is felt that the obstruction was due to infection, with swelling of the adenoids and edema of the pharyngeal tissues, rather than to a true adenoid hypertrophy. The roentgen dosage was insufficient to produce atrophy of the adenoid tissue. Furthermore, too many patients with persistent mouth breathing and nasal obstruction were seen soon after adenoidectomy to make us feel that enlarged adenoids are the main cause of the obstruction. In these cases, also, x-ray therapy produced the desired results promptly.

Nearly all the patients with ear symptoms treated with irradiation had been subjected to tonsillectomy and adenoidectomy. As pointed out above, however, the recurrence of adenoids after surgery is so frequent (75 per cent of cases) that it may be regarded as normal. This recurrent lymphoid tissue may maintain infection or become re-infected, impair the function of the eustachian tube, and produce a low-grade tubotympanic infection leading to a chronic progressive deafness. These hyperplastic infected adenoid nodules are located in and around the eustachian tube and are not amenable to surgical removal. Infected lymphoid tissue is so sensitive to irradiation that only a small dose is needed, far below the amount that could cause any irradiation injury to the mucous membrane or surrounding structures. In resistant cases we have found that increasing the dose to 125 r through the lateral nasopharyngeal port, with a lead screen 6 X 6 cm, is usually successful

without resort to the use of radium in the nasopharyngeal area. Irradiation is repeated every two or three days for four treatments. Treatment should be instituted before permanent changes occur.

Roentgen therapy has no place in chronic middle ear suppuration, otosclerosis, or any form of inner ear or nerve deafness. Its purpose is to restore the normal air passage function of the eustachian tube by cleaning up the infected swollen lymphoid tissue around the stoma.

In asthma due solely to allergy, roentgen therapy has no place. There is no question, however, as to its advantage when the cause is an upper respiratory infection with tracheobronchitis and hilar adenitis, or where an allergy and infection are combined, with the infection predominant. In the former case, the asthma usually disappears and recurs only with reinfection. In this instance asthma manifests itself not as a result of a single cold or infection of the upper respiratory area but after repeated colds. Consequently, the patient becomes sensitive to his own infection, and asthma ensues. A repetition of roentgen therapy shows the same good results as the primary series. Where combined allergy and infection of the upper respiratory tract exist, the infection probably lowers the child's resistance and makes him much more sensitive to his allergens. Roentgen therapy has its effect on the infection, thereby producing a decrease in the number and severity of the asthmatic attacks. This is indicated by a longer period of well being with less need for medication.

It has been interesting to note that most of the children we have treated had an accompanying loss of appetite, with failure to gain or maintain weight. Lethargy, loss of energy, and fatigue were also present. The loss of appetite is due either to toxicity from the infected lymphoid tissue or to mechanical difficulty (edematous tissue), or to both. The fact that the appetite usually improved after the first treatment testifies to the rapidity of the x-ray effect. Concomitantly, there is

greater activity, with increased well being, and general improvement in the attitude of the child

METHOD OF TREATMENT

Four to six roentgen treatments given over a period of three to six weeks usually constitute a course. In only a few instances has the number of treatments been increased to seven or eight. If a second course has been given, which is seldom, it has been because of a stubborn infection recurring months after good response to the first course. The total skin dosage at any one "sitting" has been considered to be less than one-fifth of an erythema dose. Technical factors used are 200 kv, 0.5 mm Cu + 1.0 mm Al filter, and 50 cm target-skin distance.

The first treatment consists of 60 to 70 r over each lateral sinus, the pharynx, and cervical regions. This covers the adenoids, pharynx, tonsils, and cervical lymph node areas. No tissues are screened or protected with this dosage.

The second treatment is given five to seven days later, 75 r are administered as in the first treatment. An additional 10 to 15 r are given to an area centered over the nasopharynx so that it receives a total of 85 to 90 r. All tissues are screened and protected except the nasopharyngeal area, which is treated through a circular portal 6 cm in diameter.

Seven days later the third treatment is given exactly as the second, with similar protection and dosage.

For the fourth treatment, seven to ten days later, there is an increase in the dosage so that the entire lateral face and cervical area receive 85 to 90 r, while the nasopharynx is given 95 to 110 r.

The fifth and sixth treatments, if required, are given two to three weeks later. The maximum dosage is 110 r to the nasopharynx and 90 r to the cervical and tonsillar area. These two treatments are not usually given and are necessary, as a rule, only in very long standing chronic cases.

Where cough predominates, chest ther-

apy is added with each treatment until the cough disappears. 50 to 60 r are given to the anterior and posterior hilar areas through 10-cm square ports for the first and second treatments. The succeeding dosages are 125 to 150 r to either the anterior or posterior chest.

In asthmatics with infection predominating over allergy, chest therapy is repeated at monthly intervals in dosages of 100 to 125 r to the anterior or posterior surfaces after a full six-treatment course has been completed.

MODE OF ACTION OF RADIATION

As has been stated, the results of low-dosage treatment are dependent on the presence of infected lymphoid tissue and adjacent tissues which are infiltrated with lymphocytes and leukocytes. It is well known that lymphocytes, polymorphonuclear leukocytes and eosinophils are markedly sensitive to radiation, whereas connective-tissue cells are radioresistant. After exposure to roentgen rays in small dosages, there is an early destruction of infiltrating lymphocytes and leukocytes, liberating antibodies, ferments, and other protective substances from the destroyed cells. Phagocytosis is instituted or increased. Bacteria are destroyed and debris is removed, resulting in resolution of the infection.

The rate of change following irradiation in the different phases of inflammation and infection corresponds to the rate at which lymphocytes, leukocytes, and eosinophils are affected.

Although most often the treatments are administered after everything else has been tried, we do not feel that they could be any more successful even if tried first. This is not true, as a rule, in treating other infections or inflammations.

ARGUMENTS WHICH HAVE BEEN OFFERED AGAINST IRRADIATION

(1) *Enlarged tonsils should be treated surgically.* Children under eight years of age rarely have tonsils with septic foci. Enlargement of the tonsils and

shows a marked reduction in size. Gagging and vomiting are probably a reflex manifestation, due to a partially obstructed passageway.

Mouth breathing and nasal obstruction are disturbing but usually of not too great significance. In very young children and infants, however, irradiation has been most successful in bringing about rapid amelioration of such symptoms, forestalling surgical removal of adenoid tissue. Our records show numerous cases that were treated three to six years ago with no recurrence of the obstructive symptoms. Here again, it is felt that the obstruction was due to infection, with swelling of the adenoids and edema of the pharyngeal tissues, rather than to a true adenoid hypertrophy. The roentgen dosage was insufficient to produce atrophy of the adenoid tissue. Furthermore, too many patients with persistent mouth breathing and nasal obstruction were seen soon after adenoidectomy to make us feel that enlarged adenoids are the main cause of the obstruction. In these cases, also, x-ray therapy produced the desired results promptly.

Nearly all the patients with ear symptoms treated with irradiation had been subjected to tonsillectomy and adenoidectomy. As pointed out above, however, the recurrence of adenoids after surgery is so frequent (75 per cent of cases) that it may be regarded as normal. This recurrent lymphoid tissue may maintain infection or become re-infected, impair the function of the eustachian tube, and produce a low-grade tubotympanic infection leading to a chronic progressive deafness. These hyperplastic infected adenoid nodules are located in and around the eustachian tube and are not amenable to surgical removal. Infected lymphoid tissue is so sensitive to irradiation that only a small dose is needed, far below the amount that could cause any irradiation injury to the mucous membrane or surrounding structures. In resistant cases we have found that increasing the dose to 125 r through the lateral nasopharyngeal port, with a lead screen 6×6 cm, is usually successful

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PATIENTS REFERRED

More than 400 children have been referred by pediatricians and general practitioners for treatments. The following reasons were offered by the referring physicians:

- 1 Failure to respond to surgical and medical treatment
- 2 Recurrent streptococcal infection of the throat in the absence of tonsils and adenoids
- 3 Persistent unexplained fever following upper respiratory infections
- 4 Poor surgical risk, as patients with (a) active rheumatic fever with infected tonsils and adenoids, (b) hemophilia with infected tonsils and adenoids, and (c) congenital heart disease

RESULTS

Although an accurate statistical report could not be compiled, it can be stated conservatively that not less than 90 per cent of all the children treated showed cure or an otherwise good result. Irradiation produced, in nearly all instances, amelioration of the symptoms for which the child was treated. It has also been noted that perennial colds and sore throats have been eliminated. If a cold does ensue following irradiation, the course is short and not persistent.

To state that the results have been gratifying belittles the enthusiastic attitude of the referring physicians and the gratitude of the parents. We are noticing that we are treating brothers and sisters of children who were treated in the past. The good results have been so consistent, so prompt, and so certain that we find ourselves restraining our enthusiasm so as not to offer too much assurance to the patient. In many instances the mothers have encouraged and requested the family physician to refer the child for irradiation.

After all the failures we see in treating malignant growth with radiation, it is gratifying to get such consistently good results from the use of x-rays in infection of the nasopharynx. These results, however, may be apparent only in this community and may not be duplicated elsewhere. Only by reports from other sections of the country will the value of the method be definitely determined.

SUMMARY

Roentgen irradiation is described as an important method of treatment in chronic infections of post-pharyngeal tissues and tonsils in children because of the results obtainable when medical or surgical methods have failed.

Cough, tonsillitis, and sore throat, cervical adenitis, gagging and vomiting, mouth breathing with nasal obstruction, ear disturbances, and some forms of asthma respond rapidly, with no less than 90 per cent good results.

Because of the low dosage used and the long interval between treatments, the method is considered safe, with no dangers. Four to six treatments are given at five to fourteen-day intervals, using 60 to 90 r to the cervical and tonsillar areas with 85 to 110 r to the nasopharyngeal area.

Because of the high degree of success obtained in this area of the country, Southern Kansas, the method is recommended to other radiologists, who are urged to report their results.

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adenoid tissue (sometimes called pharyngeal tonsil) may represent actually, in children, a natural immunity to common respiratory infection. Many of these children have been subjected to surgery in spite of the fact that they were without symptoms. Following surgery, recurrent upper respiratory infections developed, accompanied by a sore throat. We have seen and treated a number of these children, with excellent results. No patient with enlarged non-infected tonsils is subjected to irradiation, because the results are dependent on the presence of infection. The decrease in size of the tonsils and adenoids is due not to a direct action on the lymphoid tissue but to a decrease or complete eradication of infection in the post-pharyngeal area.

We have treated with irradiation many children in whom symptoms persisted after removal of tonsils and adenoids. The fact that irradiation produced such good results, after surgery failed in these patients, makes us feel that removal of the tonsils and adenoids is only one part of the treatment. The source of the infection may not be totally eradicated. The tissues surrounding and adjacent to the tonsils and adenoids are similarly infected but cannot be removed, as this would involve complete removal of the pharynx. The enlarged swollen tonsils and adenoids with pharyngitis should be compared with the swelling of adjacent lymphoid structures accompanying infection elsewhere in the body. Removal of such areas is not justifiable because the source of the infection will not have been removed or eradicated.

The best evidence we can offer to refute this argument is the fact that, where a trial of irradiation was made, it was necessary to remove the tonsils or adenoids in only four cases. On the other hand, we have treated innumerable cases after surgery failed. The good results of irradiation in these cases were all the more apparent because of the failure of surgery.

(2) *All tonsils should be removed as a prophylaxis against rheumatic fever.* To our

knowledge, no case of rheumatic fever has developed in the children we have treated with radiation, though this statement is made with reservations because of the short time elapsed in most cases and because the number of patients treated is small compared to the number of patients undergoing tonsillectomy. Also, the incidence of rheumatic fever is low in this area as compared to other sections of the country. On the other hand, we have treated successfully a number of patients with recurrent sore throats and colds in whom rheumatic fever developed after the tonsils and adenoids had been removed.

Furthermore, the recent literature on rheumatic fever in children fails to emphasize tonsillectomy as a method of treatment or prophylaxis, or the tonsils as a definite source of this infection. Struthers does not regard rheumatic fever, past or present, as necessarily an indication for the removal of tonsils.

DANGERS AND CONTRAINDICATIONS

With the dosages used by us no dangers are known to accompany irradiation. Since the dosage is low, the time interval between treatments long, and the treatment fields small, no skin changes, systemic reactions, or other deleterious effects have been noted. The eye is tolerant to the usual x-ray dose given to inflammatory tissues. The total skin dosage at any one "sitting" has been considered to be less than one-fifth of an adult erythema dose.

In spite of the fact that a plea is being made to use x-rays more frequently in this condition, such treatment should be carried out only by a qualified roentgenologist or one who has been thoroughly trained in giving x-ray treatments and having the fundamental knowledge of its dangers.

The only contraindications seen in this work are true allergy involving the mucous membranes of the nasopharynx and Vincent's angina. No response to radiation is to be expected in allergy. In Vincent's angina the throat becomes worse and symptoms are accentuated following irradiation.

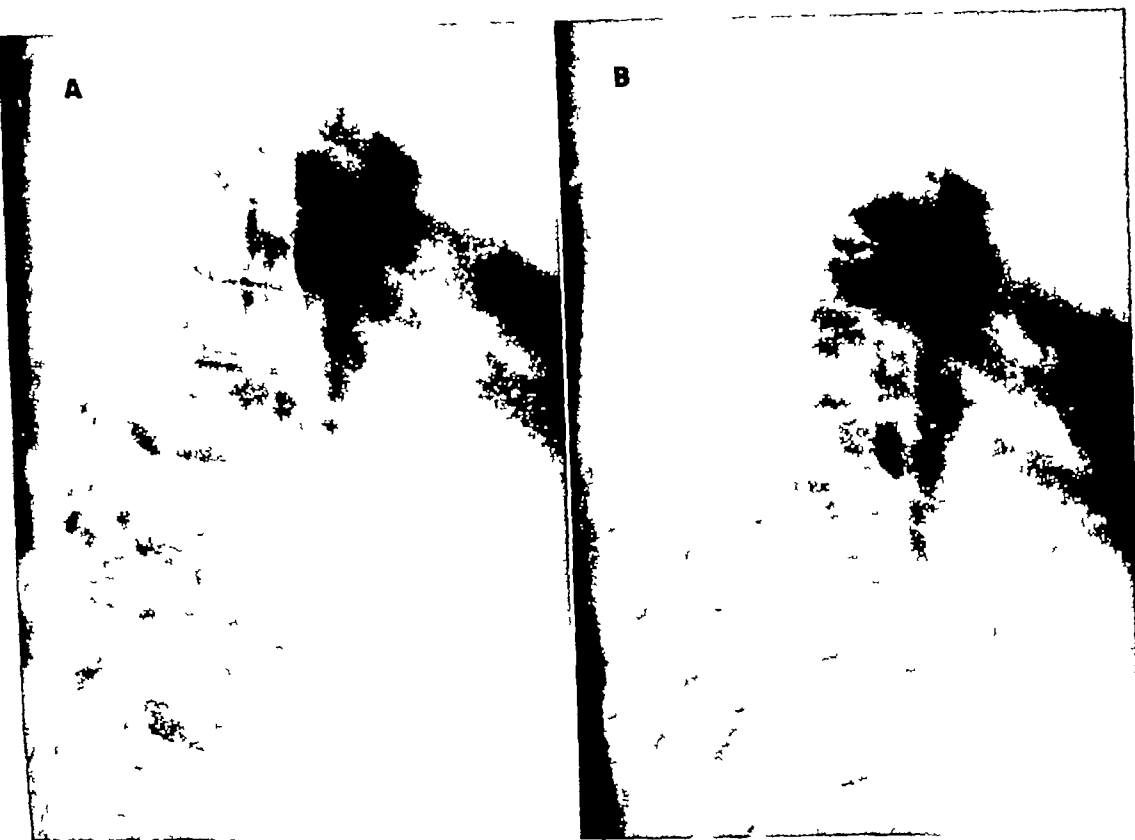


Fig 1 Roentgenograms of a 35-year old female who sustained fractures of the second, third, and fourth thoracic vertebrae following one course of electroshock treatments. A The thoracic spine on July 23, 1945, before treatment. B The thoracic spine on August 6, 1945 after treatment.

cases treated by shock therapy and compared results, from the point of view of associated fracture, in patients receiving pre-shock curare and in others who did not receive it. Of the entire group, 26.1 per cent sustained fractures of the spine, but in 275 who were given preliminary curare the incidence was only 5.8 per cent. The distribution of the injury remained the same, but the severity of the changes produced was diminished. An unexpected finding was that the highest incidence of fractures in the entire group was not in older patients, but in those under twenty-one years of age, the peak being in the age group twenty to thirty-five years. This substantiates Blumenthal's contention (3) that the muscularity of the patient plays an important part in the causation of fracture. The fourth, fifth, and sixth thoracic vertebrae suffered the greatest number of fractures, and in cases

in which osteoporosis was evident before treatment, the incidence of fracture was double that in patients with roentgenologically normal bone texture.

Our study was carried out at the McLean Hospital, Waverley, Mass., covering the months from September 1940 through February 1946. During this period of five and a half years, 230 patients received electroshock therapy, varying from a single treatment to several series of treatments. The electric current applied was calculated to produce a convulsion lasting about forty-five seconds, during which the patient was held by five attendants. No mechanical restraint or preliminary drug paralyzant was used. The attendants were experienced in this work and realized the importance of not holding the subject too rigidly. Their purpose was to absorb the initial shock of the convulsion and prevent sudden hyperflexion of the patient.

Fractures Following Electroshock Therapy¹

JAMES R. LINGLEY, M.D., and LAURENCE L. ROBBINS, M.D.

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THE INCREASING use of convulsive therapy in various psychoses and allied disorders makes it necessary for the radiologist to be familiar with the roentgen changes that may be found in the complications associated with this form of treatment. The present study was undertaken in order to evaluate the traumatic complications (fractures) incident to electroshock therapy in a group of patients treated at the McLean Hospital. It is intended to emphasize the ways in which the radiologist can be of the greatest assistance to the psychiatrist and orthopedist. The therapeutic value of the treatment as it applies to the same group will not be discussed since it has been adequately presented elsewhere (8, 9).

Since 1935, when Sakel in Vienna first reported insulin shock therapy for psychosis, the value of convulsive treatment has been more and more widely recognized, and the methods of producing shock have been investigated and expanded. Contraindications for and complications from this form of treatment were soon reported. In 1938 Stalker (7) in England and Wespi (10) from the continent each published case reports of severe fractures following convulsive therapy. Similar reports appeared in the American literature a year later. In 1939, Polatin and his associates (6) reported 51 cases of compression fracture of the thoracic vertebrae after metrazol treatment at the New York State Psychiatric Institute. This represented a 43.1 per cent incidence, with most of the cases showing multiple fractures. In all of them the thoracic vertebrae were involved, the number varying from one to eight.

Since 1939 reports of like nature have

been frequent. Drug or electroshock therapy undoubtedly produces convulsions that are often severe enough to cause dislocations and fractures not only of the vertebrae, but also of other parts of the bony structures of the body. Fracture of the pelvis, acetabulum, humerus, clavicle, and scapula have been observed. Dislocation of the jaw is not uncommon. The most frequent lesion, however, is in the spinal column, chiefly in the thoracic portion. The incidence of such fractures as reported by various investigators has ranged from zero up to 47 per cent of the patients treated.

Different means for the prevention of the traumatic complications of shock therapy have been advocated—mechanical restraint, *no* restraint, hyperextension, spinal anesthesia, pre-shock paralyzing drugs, as curare and the like. To date none has been entirely successful.

The published reports, both as to the incidence of fractures and as to the need of and the method for prevention, are extensive and contradictory. The consensus appears to be that, as a rule, vertebral fractures, except for pain, are relatively insignificant. Katzenelbogen and his colleagues (5) report the case of a patient who preferred fracture to his depression. Fracture of the long bones is a more serious complication, and fracture of the pelvis may be a cause of permanent disability. Fractures of the femoral necks have been reported fairly frequently (1). Inasmuch as some of them appear to be located subcapitally, patients with tabes (2) or those having a history of previous irradiation to the region of the femoral necks should probably not receive shock therapy.

Easton and Sommers (4) reviewed 800

¹ From the Department of Radiology of the McLean Hospital, Waverley, and of the Massachusetts General Hospital, Boston 14, Mass. Accepted for publication in April 1946.

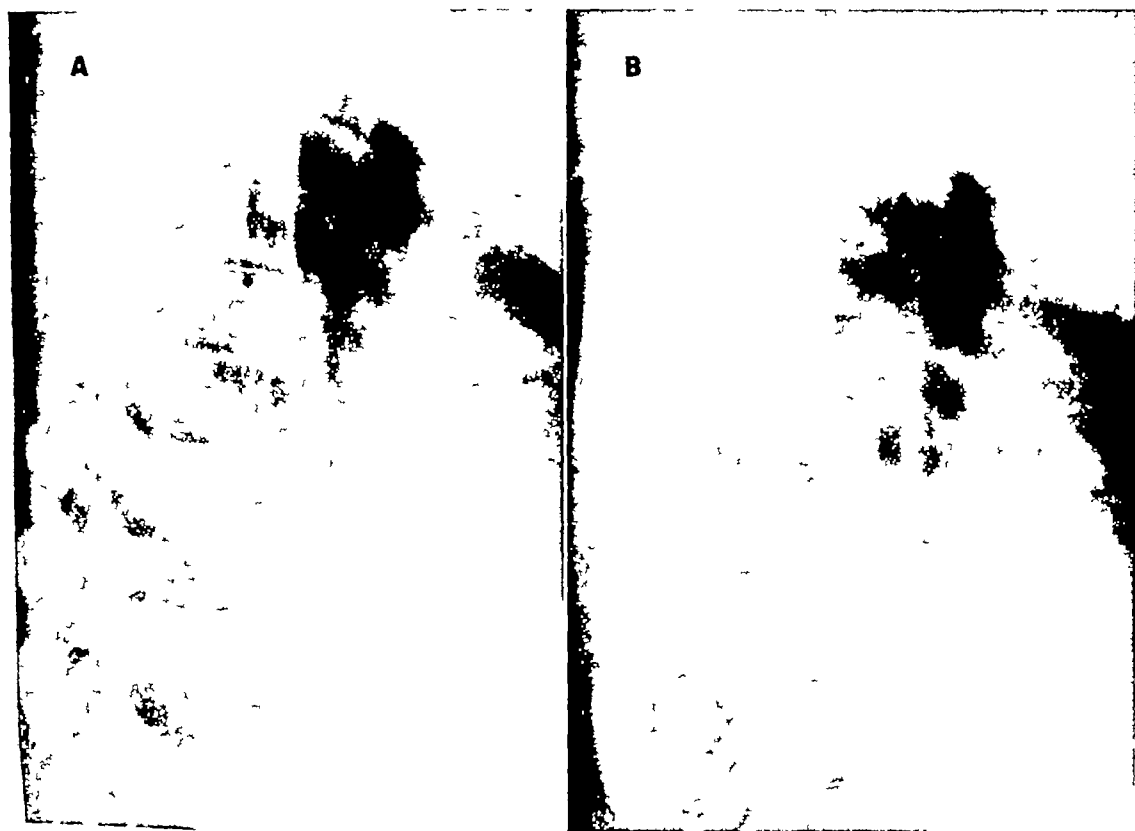


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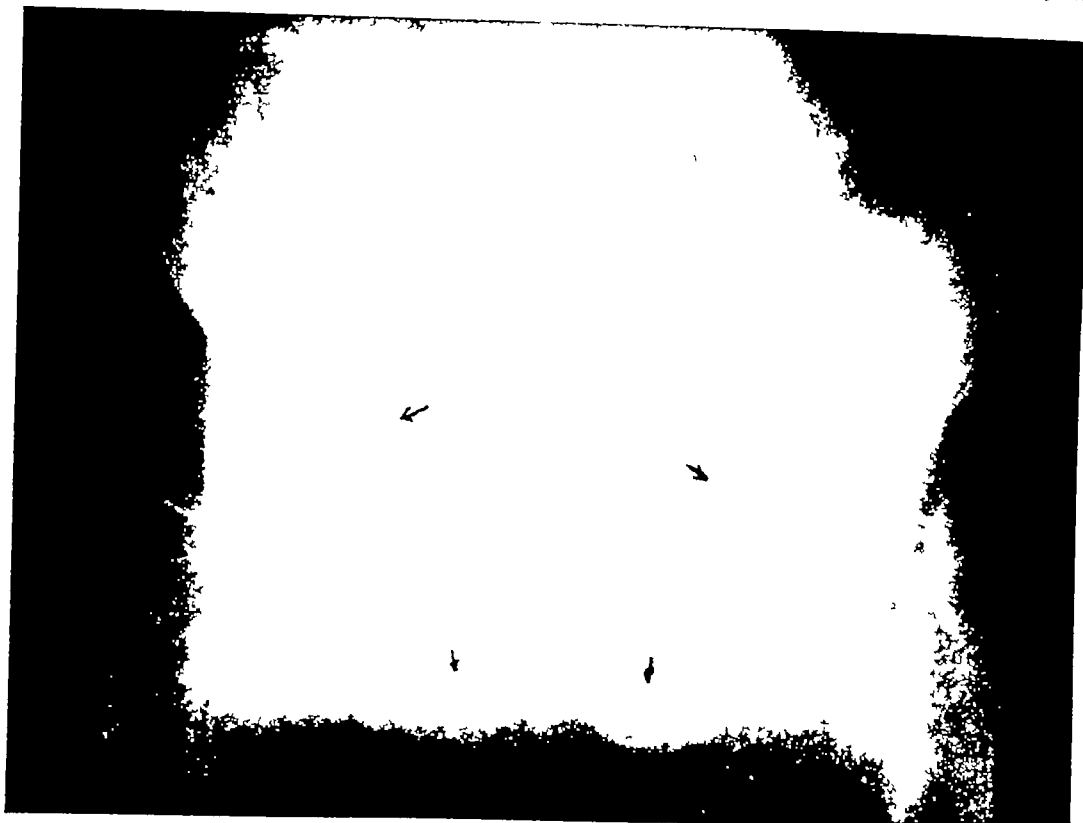


Fig 2 Roentgenogram of a 65-year-old male who sustained fractures of both acetabula and the descending ramus of both pubic bones during one electroshock treatment.

Prior to the entry of the United States into the war, it had been the custom in this institution to make a roentgenologic examination of the thoracic and lumbar portions of the spine before shock therapy in all cases and to repeat the examination on completion of the treatment. In recent years, because of shortage of film and in view of the results of earlier experience, the routine examination after treatment has been omitted. The preliminary roentgenologic examination, however, is always carried out. It had been found that in a patient who complained after treatment of pain in the region of the neck, the cervical spine usually showed no evidence of injury, but further examination often revealed a fracture of one or more of the upper thoracic vertebrae. In place of routine post-shock roentgenograms, examination is now made only of patients who complain of pain or discomfort or show

objective signs pointing to vertebral or other lesions. In reporting the incidence of post-shock fractures, therefore, it should be stated that the number is probably under- rather than over-estimated.

Of the group of 230 patients, 53 or 23 per cent sustained fracture of one or more bones. The most frequent involvement was of the spine (49 cases), the number of vertebrae fractured varying from one to five (Fig 1). Table I lists the incidence of spinal fractures, and shows the marked prevalence in the upper and mid thoracic areas, particularly at the level of T-4 and T-5. In addition to vertebral fractures, there were 3 cases of fractured pelvis. In these cases the acetabula were involved bilaterally, with intrapelvic protrusion of the femoral heads (Fig 2). Two patients showed pre-existing osteoporosis of bone. The proximal articular surface of the tibia was fractured in one case (this patient also

TABLE I ANALYSIS OF VERTEBRAL FRACTURES ASSOCIATED WITH ELECTROSHOCK

Vertebra	Number of Times Fractured
C-4	1
T-2	2
T-3	15
T-4	35
T-5	31
T-6	14
T-7	4
T-8	2
T-9	0
T-10	1
T-11	0
T-12	1
L-1	1
L-2	1
L-3	0
L-4	1
L-5	1
TOTAL	110

showed bone decalcification before treatment), in another, fracture of the sternum occurred (Fig 3)

Our experience agrees with that of others in regard to the sex incidence of post-shock fractures, the ratio being about 3 males to 1 female. Of 94 males treated, 35 or 37.2 per cent suffered fracture, among 136 females there were only 18 with fractures, or 13.2 per cent. Easton and Sommers' findings as to age and bone atrophy before treatment were also confirmed in our group. Fracture occurred most commonly in the young and in the old (Table II) and was more frequent in pa-

TABLE II AGE INCIDENCE OF CONVULSIVE SHOCK FRACTURES

Decades	Number Patients	Number Fractures
11-20 years	7	2 (28.5%)
21-30 years	45	12 (26.6%)
31-40 years	51	10 (19.6%)
41-50 years	63	8 (12.7%)
51-60 years	35	9 (25.7%)
61-70 years	25	9 (36.0%)
71-80 years	4	3 (75.0%)
TOTAL	230	53 (23.0%)

tients showing bone atrophy before treatment. Twenty-one of the group showed on pre-treatment examination varying degrees of bone decalcification, and 9 or 43 per cent of these sustained fracture. This is in contrast to a 21 per cent incidence if the osteoporotic cases are omitted. In young patients, muscularity appears to be



Fig 3 Roentgenogram of a 72-year old female who sustained fracture of the sternum during electroshock treatment. Two months previously, during treatment she had sustained fractures of the fourth and fifth lumbar vertebrae.

a causative factor, in the old, decalcification of bone predisposes to fracture.

Study of a group of 35 cases in which examination had shown old fractures of the vertebrae revealed that in the majority no change in the appearance of the fracture followed treatment. Two patients, however, showed an increase in the degree of compression of the affected vertebra. In the remainder of the group, if a new fracture was sustained, another vertebra rather than the one formerly involved was affected.

In the older age group, though extensive spur formation and other degenerative changes throughout the thoracic and lumbar spine were present before treatment, no correlation with subsequent fracture was found, nor was change in the already existing abnormalities noted.

Two patients with known Paget's disease were in the group treated. In one, with Paget's disease of L-2 and of the pelvis, fractures of T-3 and T-4 followed the first

treatment During the next two years this patient received several series of treatments and, except for slight increase in the compression of the fractured vertebrae, experienced no further ill effect. The second patient, whose disease involved T-11 and the left femur, sustained no bony injury during his treatment. Incidentally, a 14-year-old boy, showing acute epiphysitis of the thoracic spine, received electroshock treatment without complication of any kind.

At this hospital, convulsive shock fracture was not considered as a contraindication for future treatment. Fifteen patients who sustained fractures early in the course of treatment were continued on the original plan of therapy, and in only 3 was any increase in the compression observed.

CONCLUSIONS

Of 230 patients who received electroshock therapy at the McLean Hospital during a period of five and a half years, 53 or 23 per cent sustained fracture, predominantly of the vertebrae. A total of 110 fractured vertebrae were found. The incidence of fracture was greater in males than in females, and in the younger and older, rather than in the middle, age groups. It would seem, from our experience, that whether the convulsion is due to tetanus, epilepsy, therapeutic metrazol and allied drugs, or to electroshock, the number of bones fractured and the areas involved are probably dependent to a great extent upon the *severity* of the convulsion sustained.

Certain pre-existing bone conditions appear to contraindicate shock therapy,

inasmuch as their presence renders the bone more susceptible to fracture than normal bone. Such lesions include osteoporosis, malignant lesions, Otto's pelvis, possibly Paget's disease, and syphilitic lesions.

NOTE This study was made possible through the courtesy and co operation of Dr K J Tillotson and the late Dr W Sulzbach. Thanks are also due to Mr Herbert Davidson for his assistance and his painstaking technique.

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Cardiac Enlargement¹

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NO ASPECT OF heart disease has a more venerable history than cardiac enlargement, which was recognized as an indication of heart disease by the technic of palpation, and later percussion, long before other instruments of diagnosis became available. Within a few years after the advent of roentgenology, several comprehensive studies on cardiac enlargement were carried out by Moritz, Dietlen, and others, to which, in fact, relatively little has been added. Although roentgenologic study makes it possible to visualize and to explore the heart in a manner not approached by any other means, it is a fact that x-ray study of the heart in general and several aspects of proved value in particular are not utilized in clinical medicine to the extent of their potentialities. I feel that in no small measure a cause for this lies with roentgenologists and cardiologists themselves. Scarcely a year passes in which some enthusiast does not add new measurements and indices of one sort or another to an already overburdened literature. The net result has been to confuse rather than to clarify the subject, and it is small wonder that so many have come to feel that cardiac mensuration is a field of idle sophistry and employ no measurement other than the estimate of the unaided eye. The truth is that a few well tried, simple measurements introduced shortly after Roentgen's discovery suffice entirely to determine whether cardiac enlargement is present. It has been our object in the studies we have carried out to standardize the few measurements that appear most useful and to make them available in a simple form which may be readily employed. Some of you may be familiar with the nomogram chart we have devised for

this purpose, which we will presently discuss.

It would be well first to define the sphere of usefulness of cardiac measurements. Measurements are of greater value as an index of generalized enlargement of the heart than in determining the size of the individual chambers. There is a definite field of usefulness for measurement standards in evaluating enlargement of the heart as a whole, since in many instances the individual chambers are not involved distinctly, and one can state only that the heart is enlarged. Mensuration is unnecessary when gross enlargement exists, but lesser degrees of enlargement often escape detection on inspection. Conversely, an apparently large cardiac shadow may assume less significance when it is considered in relation to standards of body build. If proper account is taken of the physiological variables which influence the size of the heart, mensuration is a valuable aid in determining whether enlargement exists. Measurement is helpful, also, in comparison of changes in heart size in serial examinations in the same subject. Another field where measurement has found wide application is in physiological and pharmacological investigations of the heart.

The size, shape, and position of the heart are influenced by certain physiological variables and technical considerations which should be appreciated before deciding whether the heart is pathologically enlarged. Most measurements refer to the frontal cardiac silhouette. It is important, therefore, that the subject be centered properly, and this can be recognized in the roentgenogram by an equidistance of the inner borders of the clavicles from the mid-

¹ From the Medical Department, Equitable Life Assurance Society of the United States, New York City. Presented before the joint meeting of the New England X Ray Society and the New England Heart Association, March 15, 1946.

point of the vertebral spine. Even slight degrees of rotation may significantly alter the size of the cardiovascular shadow, particularly the aortic arch silhouette. The exposure should be made in the erect or sitting position and with respiration suspended in ordinary inspiration, since extremes of respiration or straining may cause marked variations in heart size. The size of the heart varies greatly from systole to diastole, as seen in the roentgenkymogram. Since diastole is longer than systole at ordinary heart rates, roentgenograms are more often exposed in diastole. It is not true, as is widely supposed, that a full second exposure lasting through a complete cardiac cycle will record the diastolic or largest heart shadow.

Several anatomical peculiarities may cause confusion in interpreting the heart size. The most important is an extrapericardial fat pad which merges with the lower left heart border and may obscure the apex. The margin of the fat pad must not be mistaken for the left heart border, which may be discerned within the fat pad, particularly if the roentgenogram is made with slightly over-penetrated technic. Skeletal abnormalities of the thorax, such as funnel chest and kyphoscoliosis, by displacing and distorting the heart, occasionally may render difficult the accurate determination of its size. The scoliotic spine may simulate the heart border, and a diagnosis of cardiac enlargement or dilatation of the aorta may thereby be made erroneously. The size, shape, and position of the cardiac shadow may be altered in pulmonary diseases, such as fibroid phthisis, atelectasis, pneumothorax, etc., and by elevation of the diaphragm, as in pregnancy and ascites.

Body build has a most important determining influence on the size of the heart. The correlation of heart size with various factors, such as weight, height, surface area, muscular development, thoracic circumference and other thoracic measurements, etc., has been probed extensively. The dependence on weight is somewhat greater than on height, but the correlation is improved if both weight and height are

considered. A weight/height index has been evolved which appears to serve as a satisfactory coefficient for prediction of normal standards. The influence of sex, and of age in adults, on the size of the heart is relatively small compared with the factors of weight and height, and for practical purposes may be disregarded in prediction standards.

Of the many measurements that have been advocated, the best known are the transverse, longitudinal, and broad diameters. These few simple measurements suffice to determine whether the heart is enlarged. The transverse diameter, and the area of the frontal cardiac silhouette, which may be determined from the long and broad diameters, as we will presently show, are the most thoroughly tried and standardized and among the best of all measurements. In addition, the heart volume, which is of great physiological interest, can be accurately calculated from these diameters.

The simplest, most widely employed, and one of the most useful measurements is the transverse diameter, which is the sum of the greatest extension of the right border to the right, and of the left border to the left, of the midline. The cardiothoracic ratio, which is predicated on the assumption that the transverse diameter should be less than half the transverse diameter of the chest at the level of the diaphragm, has been widely popularized, but is crude and inexact. The width of the thorax is only a rough index of body stature and, in any given case, is altered by respiration and also in pathologic conditions, such as emphysema. Ordinarily the transverse diameter of the heart is considerably less than half the transverse diameter of the chest, so that appreciable enlargement may escape detection if this ratio is employed as an index of heart size. More accurate standards, based on weight and height, have been established both for the orthodiagram by Hodges and Eyster (1) and for the teleroentgenogram by Ungerleider and Clark (2). Teleroentgenographic standards are slightly greater than those for the

orthodiagram, so that it is not proper to use the orthodiagram values in reading teleroentgenograms. Because of the increasing employment of the teleroentgenogram, a new prediction table, based on a study of 1,460 teleroentgenograms of normal subjects, was prepared, and this should be employed, rather than the older orthodiagram standards, when reading teleroentgenograms (see table on next page).

The actual transverse diameter should not be interpreted too strictly in relation to the predicted value, for there are appreciable physiologic variations in the size of the cardiac shadow in addition to changes due to the phase of the heart cycle and to respiration. Diameters which are more than 10 per cent above the predicted value should be regarded as abnormal, and the heart may be considered as almost certainly enlarged if the transverse diameter is over 15 per cent in excess of the predicted diameter, since less than 3 per cent of normals exceed this limit. An increase in the transverse diameter is most often caused by enlargement of the left ventricle, but enlargement of any of the cardiac chambers, even of the left auricle, when it forms the right border of the heart, can widen the transverse diameter.

The utility of the transverse diameter, employing our tables, has been confirmed in several studies. The conclusion of Comeau and White (3) in their article entitled "A Critical Analysis of Standard Methods of Estimating Heart Size from Roentgen Measurements" may be quoted

'1 A comparison of transverse diameters frontal cardiac area, and heart volumes in 200 normal hearts leads us to conclude that the transverse diameter of the heart compares favorably with the other actual heart measurements and is the most satisfactory from the clinical standpoint.

2 We believe that the cardiothoracic ratio is not sufficiently reliable to warrant the wide usage which it now enjoys and that it should be discarded in view of the fact that it has been superseded by a more accurate and an equally simple correlative method.

'3 We have found that the prediction tables offer the best approach to the problem of determining whether cardiac enlargement exists in an individual case. Our results indicate that the use of

the transverse heart diameter and its deviations from the predicted normal is as yet the most reliable and the most applicable clinically of the existent methods."

Recently an important study was carried out by Sherman and Ducey (4), in which a direct comparison was made between the weight of the heart at autopsy, in 200 adult males, and three types of measurement, the Ungerleider and Clark transverse diameter prediction table, the Newcomer heart-lung rectangle method, and the cardiothoracic ratio. Their findings were reported as follows:

"The values obtained by the Ungerleider method more closely approximate the enlargement by weight than do those by the other two methods, particularly in borderline cases. The Ungerleider method is the only one of the three by which enlargement of 40 per cent or less can be detected. There is constant correlation between the percentage deviation of the transverse diameter, as obtained by the Ungerleider method, and the percentage deviation in heart weight."

Two other diameters, the long and broad diameters, are well known, although these are somewhat less valuable individually than the transverse diameter. The long diameter extends from the junction of the cardiac and vascular silhouette on the upper part of the right border of the heart obliquely downward to the apex on the left. This diameter, which is approximately 10 per cent greater than the transverse diameter, is increased chiefly as a result of left ventricular enlargement. The broad diameter is the greatest diameter perpendicular to the long diameter. The broad diameter is often drawn as the sum of the two perpendiculars from the long diameter to the lower right and upper left heart borders, but properly it is the greatest single diameter from upper left to lower right heart border perpendicular to the long diameter. If the heart is placed transversely, it may be necessary to extend the lower part of the right border slightly below the diaphragm in its natural curve in order to delineate the limit of the broad diameter. The broad diameter averages about 15 per cent less than the transverse diameter.

Theoretical Transverse Diameters of Heart Silhouettes
for Various Heights and Weights

Table for Determining the Per Cent. Deviation
from Average

T.D. Heet	HEIGHT																M				A				P					
	3.0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	25%	20%	15%	10%	5%	10%	15%	20%	25%	30%	35%	40%	45%	
100 mm	83	85	86	87	89	90	92	93	95								75	80	85	90	95	100	105	110	115	120	125	130	135	140
101	85	86	88	91	92	94	95	97	100								76	81	86	91	96	101	106	111	116	121	126	131	136	141
102	87	88	90	92	94	96	97	99	101								77	82	87	92	97	102	107	112	117	122	127	132	137	142
103	88	90	92	94	96	98	99	101	103								78	83	88	93	98	103	108	113	118	123	128	133	138	143
104	90	92	94	96	98	100	101	103	105								79	84	89	94	99	104	109	114	119	124	129	134	139	144
105	93	95	96	98	100	102	104	106	108								80	85	90	95	100	105	110	115	120	125	130	135	140	145
106	94	95	97	99	100	102	104	106	108								81	86	91	96	101	106	111	116	121	126	131	136	141	146
107	95	97	99	100	102	104	106	108	110								82	87	92	97	102	107	112	117	122	127	132	137	142	147
108	97	99	100	102	104	106	108	110	112								83	88	93	98	103	108	113	118	123	128	133	138	143	148
109	99	101	102	104	106	108	110	112	114								84	89	94	99	104	109	114	119	124	129	134	139	144	149
110	101	102	104	106	108	110	112	114	116								85	90	95	100	105	110	115	120	125	130	135	140	145	150
111	103	104	106	108	110	112	114	116	118								86	91	96	101	106	111	116	121	126	131	136	141	146	151
112	106	108	110	112	114	116	118	120	122								87	92	97	102	107	112	117	122	127	132	137	142	147	152
113	108	110	112	114	116	118	120	122	124								88	93	98	103	108	113	118	123	128	133	138	143	148	153
114	110	112	114	116	118	120	122	124	126								89	94	99	104	109	114	119	124	129	134	139	144	149	154
115	112	114	116	118	120	122	124	126	128								90	95	100	105	110	115	120	125	130	135	140	145	150	155
116	114	116	118	120	122	124	126	128	130								91	96	101	106	111	116	121	126	131	136	141	146	151	156
117	116	118	120	122	124	126	128	130	132								92	97	102	107	112	117	122	127	132	137	142	147	152	157
118	118	120	122	124	126	128	130	132	134								93	98	103	108	113	118	123	128	133	138	143	148	153	158
119	120	122	124	126	128	130	132	134	136								94	99	104	109	114	119	124	129	134	139	144	149	154	159
120	122	124	126	128	130	132	134	136	138								95	100	105	110	115	120	125	130	135	140	145	150	155	160
121	124	126	128	130	132	134	136	138	140								96	101	106	111	116	121	126	131	136	141	146	151	156	161
122	126	128	130	132	134	136	138	140	142								97	102	107	112	117	122	127	132	137	142	147	152	157	162
123	128	130	132	134	136	138	140	142	144								98	103	108	113	118	123	128	133	138	143	148	153	158	163
124	130	132	134	136	138	140	142	144	146								99	104	109	114	119	124	129	134	139	144	149	154	159	164
125	132	134	136	138	140	142	144	146	148								100	105	110	115	120	125	130	135	140	145	150	155	160	165
126	134	136	138	140	142	144	146	148	150								101	106	111	116	121	126	131	136	141	146	151	156	161	166
127	136	138	140	142	144	146	148	150	152								102	107	112	117	122	127	132	137	142	147	152	157	162	167
128	138	140	142	144	146	148	150	152	154								103	108	113	118	123	128	133	138	143	148	153	158	163	168
129	140	142	144	146	148	150	152	154	156								104	109	114	119	124	129	134	139	144	149	154	159	164	169
130	142	144	146	148	150	152	154	156	158								105	110	115	120	125	130	135	140	145	150	155	160	165	170
131	144	146	148	150	152	154	156	158	160								106	111	116	121	126	131	136	141	146	151	156	161	166	171
132	146	148	150	152	154	156	158	160	162								107	112	117	122	127	132	137	142	147	152	157	162	167	172
133	148	150	152	154	156	158	160	162	164								108	113	118	123	128	133	138	143	148	153	158	163	168	173
134	150	152	154	156	158	160	162	164	166								109	114	119	124	129	134	139	144	149	154	159	164	169	174
135	152	154	156	158	160	162	164	166	168								110	115	120	125	130	135	140	145	150	155	160	165	170	175
136	154	156	158	160	162	164	166	168	170								111	116	121	126	131	136	141	146	151	156	161	166	171	176
137	156	158	160	162	164	166	168	170	172								112	117	122	127	132	137	142	147	152	157	162	167	172	177
138	158	160	162	164	166	168	170	172	174								113	118	123	128	133	138	143	148	153	158	163	168	173	178
139	160	162	164	166	168	170	172	174	176								114	119	124	129	134	139	144	149	154	159	164	169	174	179
140	162	164	166	168	170	172	174	176	178								115	120	125	130	135	140	145	150	155	160	165	170	175	180
141	164	166	168	170	172	174	176	178	180								116	121	126	131	136	141	146	151	156	161	166	171	176	181
142	166	168	170	172	174	176	178	180	182								117	122	127	132	137	142	147	152	157	162	167	172	177	182
143	168	170	172	174	176	178	180	182	184								118	123	128	133	138	143	148	153	158	163	168	173	178	183
144	170	172	174	176	178	180	182	184	186								119	124	129	134	139	144	149	154	159	164	169	174	179	184
145	172	174	176	178	180	182	184	186	188								120	125	130	135	140	145	150	155	160	165	170	175	180	185
146	174	176	178	180	182	184	186	188	190								121	126	131	136	141	146	151	156	161	166	171	176	181	186
147	176	178	180	182	184	186	188	190	192								122	128	133	138	143	148	153	158	163	168	173	178	183	188
148	178	180	182	184	186	188	190	192	194								123	130	135	140	145	150	155	160	165	170	175	180	185	<

The long and broad diameters are of interest, not so much by themselves, but for their product, *i e*, the frontal cardiac area, which is an expression of the two-dimensional size of the cardiac shadow

The area of the frontal cardiac silhouette in relation to standards based on weight and height has been widely recommended as an excellent criterion of the size of the heart. In order to ascertain the area of the frontal silhouette, the upper and lower limits of the heart shadow must be completed by arbitrary and imaginary lines, and this requires considerable experience to attain duplicable results. The area is measured by means of a planimeter, or by counting squares within the area on cross-section paper. In orthodiagraphic examination, observation of the pulsations helps in outlining the upper and lower limits of the heart contour. In the teleroentgenogram, however, the error in completing the upper and lower borders is much greater, and, for that reason, satisfactory frontal area measurements have not hitherto been obtained from the teleroentgenogram, although this method yields excellent results in orthodiagraphy in the hands of those who are well trained in the technic. Inasmuch as the cardiac shadow is ellipsoid in shape, its area may be calculated from the product of its axial long and broad diameters (area of ellipse = $\pi/4$ long \times broad diameters). Calculation of the cardiac area by means of the formula, $\pi/4$ long \times broad diameters, yields values which correspond closely to the actual area as measured by planimetry (within 3 per cent) (5). This product may, therefore, be used to estimate the cardiac area in lieu of planimetry. This is of particular advantage in the teleroentgenogram, because the long and broad diameters can be measured accurately, whereas the planimetric estimation of the cardiac area is less accurate. The product, $2/3$ long \times transverse diameters, approximates the cardiac area, but is less satisfactory than the product of long and broad diameters, for the mean deviation from actual areas, as ascertained by planimetry in 134 orthodiagrams, was

found to be 7 per cent, whereas with the long and broad diameter product the mean deviation in the same group of 134 cases was less than 3 per cent. The actual cardiac area should not exceed 10 per cent over the predicted value, if it does, the heart may be considered enlarged. Recently we prepared a nomogram for prediction of the cardiac area from weight and height, and actual area as calculated from the long and broad diameters (5). The nomogram permits the frontal area to be read directly, without calculation from the long and broad diameter measurements. Predicted values for the frontal area based on weight and height are indicated in the same nomogram chart on another scale (see next page).

The validity and usefulness of the nomogram for frontal area has been confirmed by Kurtz (6) on the basis of 155 cases tested. Kurtz reported "This relatively close approximation to the planimetric area indicates that the method has a practical application of distinct value in the great majority of cases." He states further

"Most cardiologists will admit that the cardiothoracic ratio is the poorest roentgenographic method of detecting cardiac enlargement, whereas orthodiagnostic measurement of the frontal area of the cardiac silhouette is probably the most accurate. The latter has the obvious disadvantage of requiring a considerable amount of training in the technique. If the other disadvantages of measuring the frontal area, namely, the completing of the upper and lower borders and the use of a planimeter, could be obviated one would have an ideal method for even the untrained. The method proposed by Ungerleider and Gubner approaches the ideal."

To summarize our discussion of cardiac measurements, it is evident that with the use of either or both the transverse diameter and the nomographic determination of frontal area, we have two simple and accurate methods which suffice to determine whether cardiac enlargement is present.

Roentgenologic examination of the heart should invariably include observation of the aorta, for abnormalities such as widening, tortuosity, and calcification occur frequently in heart disease, particularly in

hypertensive and arteriosclerotic heart disease and in syphilis. Measurement of the true caliber of the aorta is difficult, because both contours are not visualized in the frontal position. The left border of the descending aortic arch is visualized in the frontal roentgenogram, and, if the esophagus is filled with barium, the right border of the aorta is indicated by the aortic indentation of the esophagus, therefore, the diameter at this level of the aorta can be ascertained by subtracting 2 mm, representing the thickness of the esophageal wall (Kreuzfuchs' method). The method is not dependable when the aorta is tortuous and the aortic knob projects to the left. Where a portion of the aortic knob is distinct, as is usually the case in adults, the true diameter of the aorta at this level may be ascertained by the simple method we have proposed, of completing the circle, of which the aortic knob is an arc, by means of a compass (7). The caliber of the aorta determined by this simple procedure checks exactly with the diameter obtained by visualization of the aorta in the left anterior oblique position and with the Kreuzfuchs' method. The diameter of the transverse arch of the aorta can frequently be measured directly in the left anterior oblique position, particularly when some degree of emphysema is present to aid contrast, or when overpenetration technic is employed. The diameter of the aorta at this level averages 3.0 to 3.5 cm in adults, varying from 2.0 to 4.0 cm, depending on body build and age.

These methods indicate the size of the transverse and descending aortic arch, but it is the ascending aorta which is most often enlarged in disease. The first portion of the ascending aorta is buried in the cardiac shadow and cannot be studied by any means except contrast visualization with diodrast. The diameter of the ascending aorta just above the aortic valve normally is 25 per cent greater than the diameter of the transverse arch at the level of the aortic knob. The ratio does not hold in pathological states, as the ascending aorta usually becomes dilated to a much greater degree

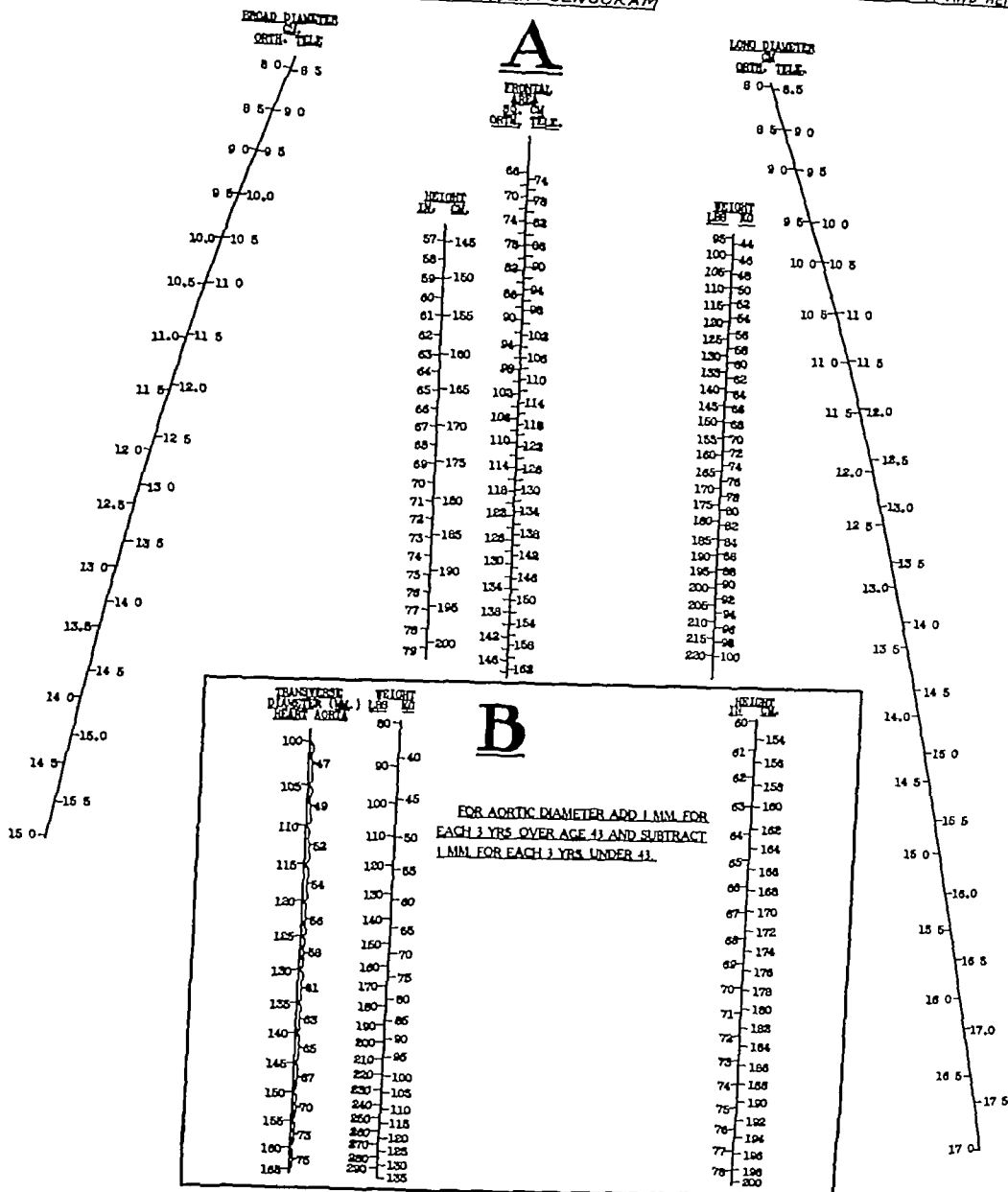
than the transverse or descending arch. Enlargement of the ascending aorta is evidenced by prominence of the right border of the vascular pedicle and by a forward bulge of the anterior border of the aorta above the cardiac shadow as observed in the left anterior oblique view.

The right border of the vascular pedicle is formed by the superior vena cava in the majority of young subjects, in later life it is more frequently formed by the right border of the ascending aorta. An increase in the transverse diameter of the vascular pedicle in the frontal roentgenogram does not specifically indicate enlargement of the aorta, for this may result from tortuosity alone, however, this measurement is useful in that it does distinguish between a normal and abnormal aorta. In a recent study, it was found that the transverse aortic diameter in normal subjects is closely related to weight and height. The table established for predicting the transverse diameter of the heart from weight and height may be employed equally well for the aortic arch diameter (8). A correction for age is necessary, 1 mm is added for each three years over the age of 43, and subtracted for each three years under the age of 43. Deviations from the predicted value up to 10 per cent are within allowable normal limits, but deviations in excess of this are infrequently seen, and the aorta may be considered as almost certainly abnormal if the diameter exceeds 15 per cent above the predicted value, for 92 per cent of normal subjects fall within this range. The transverse diameter of the aortic arch is a simple and valuable standard for measurement of the aorta. It is important that the roentgenogram be made with the subject properly centered, for even slight rotation into the oblique positions markedly alters the diameter. If it is found to exceed normal values, further study in the left anterior oblique position is indicated, for the aortic arch is best visualized in this view.

Interpretation of the heart size should not be confined to measurements. As far as is possible, enlargement should be de-

Nomograms for Area and Transverse Diameter of frontal heart silhouette

- A** PREDICTED AREA FROM WEIGHT AND HEIGHT¹ AND ACTUAL AREA FROM LONG AND BROAD DIAMETERS
 $(A = \frac{1}{2} L \times B)$ FOR ORTHODIAGRAM AND TELEORIENTGENOGRAM
B TRANSVERSE DIAMETER OF HEART² AND AORTIC SILHOUETTE³ PREDICTED FROM WEIGHT AND HEIGHT,
 FOR TELEORIENTGENOGRAM



THE VALUES FOR ACTUAL (OR PREDICTED) AREA ARE READ AT THE POINT AT WHICH A STRAIGHT LINE EXTENDING FROM THE LONG AND BROAD DIAMETERS (OR WEIGHT AND HEIGHT) INTERSECTS THE CARDIAC AREA SCALE. ORTHODIAGRAM VALUES ARE ON THE LEFT, TELEORIENTGENOGRAM VALUES ON THE RIGHT. IN THIS LOWER NOMOGRAM THE PREDICTED TRANSVERSE DIAMETER OF THE HEART (LEFT SIDE OF SCALE) OR AORTIC ARCH (RIGHT SIDE OF SCALE) IS OBTAINED AS AN EXTENSION OF A STRAIGHT LINE CONNECTING HEIGHT AND WEIGHT. A CORRECTION FOR AGE, AS INDICATED, IS NECESSARY FOR THE AORTIC DIAMETER.

in the roentgenogram. Posterior enlargement of the left ventricle is best evaluated on fluoroscopic examination in the left anterior oblique position. On rotation into that position, the posterior surface of the left ventricle clears the anterior border of the spine at an angle not greater than 60 degrees. When marked enlargement is present, the left ventricular border may not clear the spine even on rotation into the full left lateral position. While enlargement laterally, downward, or posteriorly may predominate in slight degrees of enlargement, extension of the left ventricular border in all directions occurs in more advanced stages.

It is not generally appreciated that the electrocardiogram is more sensitive than roentgenologic methods in detecting left ventricular hypertrophy. The electrocardiographic pattern of left ventricular hypertrophy, or strain, has been recognized for a long time, but specific criteria indicating the point of departure from normal were not established prior to an analysis of some 940 cases carried out by us (10). On the basis of this study, left ventricular hypertrophy may be considered to be present when left axis deviation occurs in association with any of the following changes:

- (1) Increase in amplitude of the Q R S complex, best expressed by the sum of R_1 and S_3 . Hypertrophy is present if this sum exceeds 2.5 millivolts and is probably present if it is over 2.2 millivolts. The increase in voltage is the earliest electrocardiographic change in hypertrophy.
- (2) Any perceptible depression of the S-T segment in lead I, even of as slight degree as 0.5 mm (0.05 millivolt).
- (3) Lowering of T_1 below 1.0 mm or further degrees of abnormality of T_1 .

The changes in the S-T segment and the T wave may develop in the absence of left axis deviation. The latter is not an invariable or necessarily integral part of the electrocardiographic pattern of left ventricular hypertrophy. The usual occurrence of left axis deviation with left ventricular hypertrophy in hypertension is due largely to predominant obesity, with transverse

position of the heart, which in itself causes left axis deviation. In slender subjects with left ventricular hypertrophy, left axis deviation is not so frequently observed.

Employing our criterion, we found, in 100 subjects with advanced hypertensive disease, that evidence of left ventricular hypertrophy on the electrocardiogram was present considerably more often than were roentgenologic changes. Electrocardiographic and roentgen changes do not of necessity parallel each other. While electrocardiographic abnormalities occur relatively more often than roentgenologic changes, not infrequently there may be definite evidence of left ventricular enlargement in the roentgenogram while the electrocardiogram is quite normal. Particularly is this the case where concurrent right ventricular enlargement is present, the opposite electrical effects of these chambers balancing each other.

A typical electrocardiographic pattern occurs in right ventricular hypertrophy, consisting of right axis deviation and S-T segmental and T changes in leads 2 and 3. However, this is not as specific as the left ventricular pattern, as it may be simulated in normal individuals of long narrow build, with vertically placed hearts, and occurs also in emphysema. Auricular hypertrophy may be indicated in the electrocardiogram, too, by tall, wide, and notched P waves, but these changes likewise are not specific, as they may occur in other circumstances. In general, then, the electrocardiogram is most valuable in detecting left ventricular hypertrophy. For the other cardiac chambers roentgenologic methods are unquestionably superior.

The right ventricle does not participate in forming the cardiac contour in the postero-anterior projection, since it forms the anterior surface of the heart. Nevertheless, enlargement of this chamber is indicated indirectly in this position. As the right ventricle increases in size, it displaces the right auricle to the right, causing increased prominence and convexity of the right border. Even more characteristic is a straightening and increased prominence

scribed in terms of the chambers involved since characteristic changes occur in various types of heart disease. As stated above, measurements are of greater value as an index of generalized enlargement of the heart than in determining the size of the individual chambers. Diodrast visualization of the cardiac chambers makes more detailed study possible, but this highly specialized technic is not likely to be widely employed. The relation of the heart to adjacent structures such as the esophagus and bronchi, as determined by fluoroscopy or teleroentgenography in frontal and oblique positions, is of greater value than mensuration in detecting enlargement of the individual chambers.

Fluoroscopy, technically the simplest as well as most generally available of roentgenologic procedures, provides the most information and should precede any further x-ray study. Fluoroscopy is not well suited, however, for absolute measurement of the heart size, since the image is considerably magnified, due to divergence of the x-ray beam as a result of the short tube-film distance usually employed in fluoroscopic examination. The degree of magnification depends not only on the tube-film distance, but on the object-film distance, as well. Magnification is, accordingly, greater in subjects with deep chests, in whom the heart contours are further removed from the film, than in slender subjects and children.

Magnification can be obviated by orthodiagraphy or by a simple procedure we have previously described (9). A lead scale placed vertically parallel to the cassette alongside the subject, in the plane of the anterior axillary line, is magnified exactly in the same proportion as is the heart silhouette. The scale is recorded with the heart in the same exposure of the fluoroscopic screen or roentgenogram and serves as a reference scale for measurement of the heart size. This procedure is equally suitable for 35-mm. or 4×5-inch photographs of the fluoroscopic image, a technic which is being increasingly employed, particularly in military and industrial surveys.

It may be of interest to review certain aspects of enlargement of the individual heart chambers. The four cardiac chambers are individual functional units and react independently to the strain imposed by various lesions. Abnormalities in the cardiac configuration should always be considered in terms of the chambers involved. It is more informative to describe the individual chambers specifically than to employ less precise phrases, such as enlargement to the left or to the right, or such terms as "mitral" or "aortic" configuration. The shadows of the separate chambers merge imperceptibly in the cardiac shadow, but the contours in frontal and oblique projections permit adequate differentiation and visualization of all the chambers.

The configuration of the enlarged left ventricle varies somewhat depending on whether hypertrophy or dilatation predominates. In the earlier stages of hypertensive heart disease, for example, there may be considerable myocardial hypertrophy with relatively little dilatation (concentric hypertrophy). Hypertrophy as such is a matter of increase in the thickness of the left ventricle of only a few millimeters and so does not perceptibly alter the dimensions of the cardiac shadow. The left ventricular border, however, is characteristically altered in concentric hypertrophy, becoming increasingly convex, *i e.*, more rounded.

Enlargement of the left ventricle occurs downward, laterally, and posteriorly. Downward enlargement is recognized by elongation of the left ventricular contour, the apex extending to the sixth intercostal space. This type of enlargement is seen particularly in aortic insufficiency, where dilatation of the left ventricular cavity predominates, the diastolic volume necessarily being large because of the increased systolic output. Enlargement of the left ventricle laterally is evident by extension of the left ventricular border outside the midclavicular line. This criterion is the one regularly employed on physical examination, but can be applied even more accurately

enlargement is present, the esophagus is displaced far backward against the anterior border of the vertebrae. Minimal left atrial enlargement is best detected by administering a thick barium paste which adheres to the esophageal mucosa, outlining it for some length of time after swallowing. It is inadvisable to expose roentgenograms during swallowing of a thin barium mixture such as is used in gastro-intestinal study, for the barium bolus can indent the left atrium during deglutition so that lesser degrees of retrodisplacement of the esophagus will escape observation. The esophagus is displaced not only posteriorly but somewhat to the right, which is revealed by rotating the subject into the postero-anterior or anteroposterior position after examination in the right anterior oblique view. Posterior displacement of the esophagus is the earliest and most certain sign of enlargement of the left atrium, and usually antecedes other changes such as obliteration of the infrabronchial space, elevation of the left main bronchus, or straightening of the upper left heart border.

One aspect of left atrial enlargement merits comment. In certain cases with a long-standing free mitral insufficiency, marked enlargement of the left ventricle and tremendous dilatation of the left atrium occur. The left atrium displaces the esophagus posteriorly against the right, coming to form not only the entire right heart border, but in extreme cases occupying the entire lower thoracic cavity. This constitutes a unique clinical syndrome (7). Despite the remarkable enlargement of the heart, which exceeds that seen in any other condition, there is frequently a surprising freedom from symptoms of impaired cardiac reserve, and the patient may continue for years with relatively little limitation of activity. The freedom from pulmonary congestion may be due to the enormously dilated left atrium acting as a reservoir between the heart and lungs. This condition develops most frequently in subjects in the third and fourth decades with a long-standing

history of rheumatic heart disease. Auricular fibrillation invariably is present. Occasionally a marked systolic heave may be palpated over the right lower anterior chest due to systolic distention of the enlarged atrium resulting from free mitral regurgitation. The systolic distention of the left atrium can be observed in roentgenkymograms, which also show large amplitude of the left ventricular contractions with very rapid filling in early diastole from the distended left atrium.

The right atrium (auricular portion) forms the entire right heart border. Enlargement results in extension of the right heart border laterally. Prominence of this contour, however, is not specific, since a prominent right heart border may result from enlargement of any of the cardiac chambers, particularly the right ventricle, displacing the right atrium to the right. Enlargement of the right atrium usually occurs as part of generalized cardiac enlargement, almost never as an isolated clinical entity. Enlargement of this chamber is most noteworthy in tricuspid valvular disease.

Extension of the right cardiac contour simulating right atrial enlargement occurs in pericardial effusion. It may be relevant to speak briefly of pericardial effusion, for the problem frequently arises of differentiating pericardial effusion from generalized cardiac enlargement. Since the various clinical features may be inconspicuous, the existence of pericardial effusion, even of appreciable size, may be unsuspected, and its presence may be disclosed inadvertently during routine roentgen examination of the chest. Roentgenologic examination provides the most certain diagnostic evidence, apart from paracentesis, when pericardial effusion of any considerable amount is present.

The roentgen appearance of pericardial effusion frequently is characterized by such terms as bottle-shaped, bag-shaped, or triangular. It should be emphasized, however, that the appearance of pericardial effusion in the roentgenogram is extremely variable. There is no one configuration

of the upper left heart border between the aortic arc and the left ventricular segment. This results from elevation and rotation of the pulmonary artery by the enlarged outflow tract or infundibular portion of the right ventricle so that its contour becomes more prominent than the normal pulmonary artery curve. The term "prominent pulmonic conus" is commonly employed to describe these changes. Actually, the conus, or infundibular portion of the right ventricle, appears on the upper left heart border only in advanced cases. When right ventricular hypertrophy is marked, with relatively little dilatation, as in congenital cardiac lesions such as the tetralogy of Fallot, a characteristic change in the left heart border is observed. The apex is elevated by the hypertrophied body of the right ventricle (inflow tract), producing a rounding of the lower left contour (*cœur en sabot*).

The right ventricle is best studied by examination in oblique views. In the right anterior oblique position, a forward bulge of the infundibular portion of the right ventricle (outflow tract) toward the sternum is observed. A rounding and anterior extension of the lower right ventricular border observed in the left anterior oblique position occurs at a somewhat later stage. This is indicative of hypertrophy of the body of the right ventricle (inflow tract).

The left atrium forms the posterior surface of the heart and does not contribute to the cardiac silhouette in the postero-anterior projection except for a small and variable segment of the left auricular appendage above the left ventricular border. The left atrium enlarges posteriorly and to the right, and only in slight degree to the left. Occasionally the enlarged left auricle projects to the left, causing a slight bulge above the left ventricular contour. Ordinarily, however, the filling in and straightening of the "cardiac waist" above the left ventricle which are characteristically observed in mitral valvular disease (the commonest cause of left atrial enlargement) are due chiefly to associated right

ventricular enlargement displacing the pulmonary artery, rather than to left atrial enlargement *per se*. Rarely, in cases with marked left atrial enlargement this chamber may project considerably from the upper left heart border.

A much more frequent finding in the presence of marked left atrial enlargement is extension of the left atrium to the right, with projection beyond the border of the right auricle. A double festoon results. The left atrium may in certain cases with free mitral insufficiency become massively dilated, coming to occupy the lower half of the right thoracic cavity.

Oblique views are indispensable to establish the presence of lesser degrees of enlargement of the left atrium. In the left anterior oblique position, the left atrium forms the upper portion of the posterior cardiac border. Normally a space of approximately a finger's breadth is present between the upper border of the left atrium and the left main bronchus. As the atrium enlarges, this space becomes obliterated. Further degrees of enlargement elevate and ultimately compress the bronchus. It must be emphasized that elevation of the left main bronchus is not an early sign of left atrial enlargement. It is preceded by obliteration of the infrabronchial space (7), a sign which has not hitherto received attention.

The right anterior oblique or right lateral position ordinarily gives the earliest indication of left atrial enlargement. The left atrium enlarges posteriorly into the retrocardiac space. This is evident directly on fluoroscopic examination or in the roentgenogram when well marked, but the detection of this change is greatly facilitated by outlining the esophagus with barium. The esophagus pursues a vertical course in the posterior mediastinum directly behind and in apposition with the posterior surface of the heart (left atrium). As the left atrium enlarges, the barium-filled esophagus is indented and displaced posteriorly in the retrocardiac space, beneath the impressions of the left main bronchus and the aortic arch. When marked atrial

posterior left ventricular border and even in the presence of marked cardiac enlargement the pulsations do not diminish to the same degree as the apical pulsations in the postero-anterior position. Pericardial effusion accumulates early in this region, and in the left anterior oblique position the left ventricular pulsations become obscured as the fluid collects in the inferior pericardial recess. When the effusion is large, the lower posterior cardiac contour may be seen to sag into the diaphragm, indenting the stomach. Inflation of the stomach with an effervescent mixture aids study of the pulsations of the inferior cardiac surface.

The cardiac pulsations are best studied by means of roentgenkymography. While diminution of the cardiac pulsations, as mentioned, is not specific, the disparity between the amplitude of pulsations of the descending aorta, which tends to remain normal, and the greatly diminished amplitude of left ventricular pulsations is suggestive of pericardial effusion.

It has been reported by some that a double density distinguishing the heart shadow within the borders of the effusion can be observed occasionally in cases of pericardial effusion, but the validity of this sign has been denied by most authoritative observers, nor have we ever encountered this finding in a case of pericardial effusion. Holmes (11) investigated this question experimentally by injecting fluid into the pericardial sac of dogs and was not able to discern any difference in radiographic density between the heart and pericardial contents.

Contrast visualization of the heart by means of diodrast offers a method whereby the cardiac chambers may be clearly outlined within the effusion. An overpenetrated roentgenogram exposed two to three seconds after the rapid injection of 30 to 45 cc of 70 per cent diodrast visualizes the right auricle, and the outline of this chamber can be clearly demarcated from any surrounding pericardial effusion. Visualization of the other cardiac chambers with diodrast is not as satisfactory as that

of the right auricle unless the multiple exposure technic is employed, due to the dilution of the dye in the pulmonary vascular bed, uncertainty as to the speed of the circulation of the diodrast through the lungs to the left side of the heart, and the possibility of exposing the roentgenograms when the heart is contracted and relatively empty, in systole. However, the right auricle can be visualized regularly without difficulty, and the finding of a double contour provides a pathognomonic sign of pericardial effusion.

We have devoted the greater part of this presentation to a discussion of cardiac measurements and to certain phases of cardiac enlargement which have interested us, such as electrocardiographic changes in left ventricular hypertrophy, the lead scale method to replace orthodiascopy, obliteration of the infrabronchial space as a sign of left atrial enlargement, the arc method of determining the diameter of the aorta, diodrast diagnosis of pericardial effusion, and tables and nomograms for transverse diameter and frontal area. I do not wish to leave the impression, however, that the recognition of enlargement is the only important consideration in roentgenologic study of the heart. Time does not permit us to go into detail, but we have already briefly indicated that fluoroscopic study of the individual heart chambers is an invaluable aid in various types of heart disease. Observation of the cardiac pulsations also contributes information, particularly in cardiac infarction, constrictive pericarditis, and pericardial effusion. The cardiac pulsations may be analyzed objectively by means of roentgenkymography, a technic which has proved of value not only in clinical problems but in physiological studies as well, such as determination of cardiac output. One of the really significant advances in cardiac roentgenology in the past few years has been the technic of contrast visualization of the cardiac chambers with diodrast, introduced by Robb and Steinberg (12). The application of the method has been advanced notably with the multiple ex-

typical of a pericardial effusion, as contrasted with enlargement of the heart, all the more since the shape of the enlarged heart shows great variation, depending on the chambers involved. If there is any configuration suggestive of effusion, it is generalized enlargement of the cardiac shadow with loss of the characteristic shape due to obliteration of the normal contours of the chambers and great vessels. No alteration in shape is evident until a large amount of fluid has accumulated, and it is generally accepted that effusion less in amount than 10 to 12 ounces cannot be discerned with any certainty.

Several authors have called attention to a change in the angle at the junction of the right lower heart border and the diaphragm. We have not found this sign to be of any value, since the right cardiophrenic angle, which varies greatly in enlarged hearts in the absence of effusion, may remain either unchanged or become increasingly acute or, conversely, more obtuse.

When the effusion is large, the fluid extends upward, distending the pericardium near its attachment to the great vessels, obliterating the aortic arch and pulmonary artery curves. The shadow of the vascular pedicle becomes foreshortened and broadened. This change in the shape at the base may be accentuated by examining the patient in the recumbent position with the head and chest tilted downward. A marked shift in the shape of the cardiac shadow on rotation from the right to the left lateral recumbent position is a helpful sign, but such shifts must be interpreted with reserve unless marked, since the position and shape of the enlarged heart, too, may change with shift in body position.

A rapid change in size of the cardiac shadow on serial examination is more suggestive of pericardial effusion than the appearance at any one time. Contrary to usual belief, the heart, as revealed by roentgen study, does not as a rule dilate to any considerable degree in heart failure.

It is unusual to observe marked changes in the size and shape of the cardiac shadow over a short period of time in any of the commoner types of heart disease. Roentgenologic examination at frequent intervals is therefore an aid in the diagnosis of pericardial effusion when progressive changes in the size of the cardiac shadow can be demonstrated on successive examinations.

In acute pericardial effusion, the restraining influence of the pericardium may cause cardiac tamponade. Signs of obstruction to the circulation play a prominent part in the clinical picture, such as paradoxical pulse, small pulse pressure indicative of diminished cardiac output, and increased venous pressure. In chronic pericardial effusion, however, there may be remarkably little or no interference with the circulation, since the pericardium is gradually distended and its capacity is greatly increased. Clear lung fields, free of any pulmonary congestion, are frequently observed in chronic pericardial effusion. When the heart is markedly enlarged as the result of heart disease, on the other hand, some degree of pulmonary congestion is usually present. Marked enlargement to the right, as seen in massive enlargement of the left atrium and tricuspid valvular disease, may simulate the roentgenologic appearance of pericardial effusion, but these lesions may be clinically differentiated. As a general rule, enlargement of the cardiac shadow considerably to the right in the absence of peripheral and pulmonary congestive changes is a typical finding in pericardial effusion.

Characteristically, pulsations along both heart borders are greatly diminished in the presence of a considerable effusion into the pericardium, but this sign must be interpreted with reserve. The pulsations of the lower heart borders are frequently greatly diminished when the heart is markedly enlarged due to any type of organic heart disease. Study of the pulsations in the left anterior oblique position is of value. Normally vigorous systolic pulsations of large amplitude are observed over the lower

posterior left ventricular border and even in the presence of marked cardiac enlargement the pulsations do not diminish to the same degree as the apical pulsations in the postero-anterior position. Pericardial effusion accumulates early in this region, and in the left anterior oblique position the left ventricular pulsations become obscured as the fluid collects in the inferior pericardial recess. When the effusion is large, the lower posterior cardiac contour may be seen to sag into the diaphragm, indenting the stomach. Inflation of the stomach with an effervescent mixture aids study of the pulsations of the inferior cardiac surface.

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posure method (13) and has proved of particular value in the diagnosis of congenital cardiac lesions (14)

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Benign Ulceration Within a Duodenal Diverticulum

Report of a Case¹

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DIVERTICULOSIS of the duodenum is seen frequently enough that the lesion can no longer be called uncommon. On the other hand, benign primary ulceration of the small bowel, except in a Meckel's diverticulum, is still a rarity. The combination of the two lesions, namely, a benign primary ulcer within a duodenal diverticulum, must be a rare condition indeed. Buckstein (1a) states that at times a diverticulum may give rise to symptoms as the result of ulceration but cites no specific case. The present writer, in a review of the literature on diverticulosis and primary ulceration of the small bowel, was unable to find a single instance of this character. Although the case being presented has not been proved from the pathologist's point of view, it exhibits the usual radiographic signs of benign ulceration as seen elsewhere in the gastrointestinal tract, both in the acute phase and in interval stages to complete healing. Aside from the fact that the lesion is a rarity, the case is of importance as emphasizing certain facts relative to diagnosis and the clinical significance of such a lesion.

CASE REPORT

N. L. B., a 77 year old white male, was first seen on Feb. 6, 1945. About fifty five years earlier he had experienced an attack of right sided abdominal pain of about ten days duration which confined him to bed. In subsequent years he had occasional attacks of mild diarrhea followed by generalized dull abdominal pain of one to two days' duration. These episodes never confined him to bed and usually abated after he had modified his diet to one of a bland nature. He always felt that the ingestion of eggs bore a definite causal relationship to these attacks.

In the spring of 1942 the patient was operated upon for a gangrenous appendix, following which he made an uneventful recovery. In July 1942, while in a hospital in Toronto, Ont., for an eye op-

eration, he had a moderately severe attack of steady epigastric pain following the ingestion of tomato juice. Morphine was necessary to control the pain. In the first week of February 1945, he again experienced a dull, aching epigastric pain, more to the left of the mid line, occasionally radiating to the precordial area. There was no pain down either arm. Biliary calculi were excluded by cholecystography.

On the night of March 12, 1945, the patient had the most severe attack experienced to date. There was a sudden onset of severe, steady epigastric pain, characterized as heavy and aching in nature. Again the use of morphine became necessary. There was no pain over the precordium or radiating to either arm. The blood pressure was 145/90, and the temperature remained normal. The white blood cell count was normal, with 76 per cent neutrophils. Previous electrocardiograms, and one subsequent to this attack, showed essentially normal tracings, with no evidence of coronary disease.

On the morning following this attack, a gastrointestinal examination was made. The esophagus, stomach, and duodenal bulb appeared normal, although there was generalized epigastric tenderness which could not be precisely located over any one area. Not seen on the fluoroscope, but observed on the films, was a large, walnut-sized diverticulum arising from the inner aspect of the junction of the third and fourth portions of the duodenum. In the right lateral wall of the diverticulum was an ulcer crater about 4 mm. in diameter, with some induration and edema at its base. At the end of four hours there was a minimal amount of barium clinging to the mucosa of the antral portion of the stomach, the duodenal bulb remained completely filled, and a small amount of the opaque medium was retained in the ulcer crater. The diverticulum, however, had completely emptied itself. The impression at this time was benign ulceration within a duodenal diverticulum.

The patient was placed on a strict ulcer regimen and re-examined thirteen days later. The ulcer crater was again demonstrated, both on the roentgenogram and on fluoroscopy, which was carried out in the horizontal as well as the upright position. Some tenderness was still present, and at this time could be definitely located over the diverticulum and not over the duodenal bulb. There did not appear to be any induration at the base of the ulcer at this examination, however. A four-hour film showed no evidence of retained barium in either the ulcer

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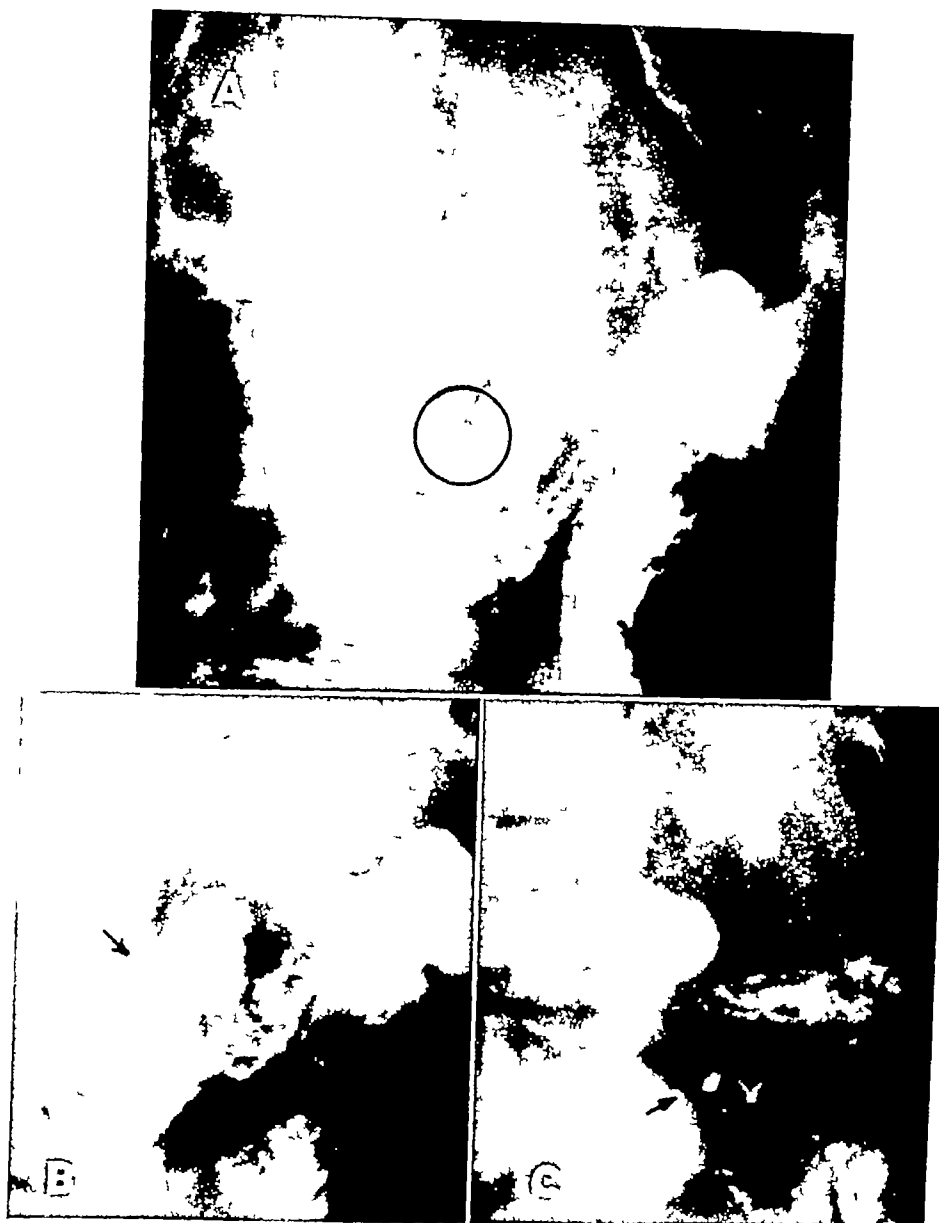


Fig 1 First examination A Ulcer crater in lateral wall of duodenal diverticulum, showing induration and edema at the base B Crater as seen in a profile view C Retention of barium in the crater after four hours

crater or any portion of the upper gastro intestinal tract. Clinically, the patient felt somewhat improved. He continued to follow an ulcer program and shortly returned to work.

Eight months later, at the author's request for a follow up study, the patient was re examined. The diverticulum was well visualized fluoroscopically and radiographically, but no evidence of an ulcer could be found. There was slight generalized soreness over the entire epigastrium on deep palpation, but no localizing tenderness was present. Routine

and pressure spot films failed to show any evidence of ulceration in the previously affected area of the diverticulum. The impression at this time was benign ulceration of a duodenal diverticulum which, according to all radiographic criteria, had healed.

At this writing, the patient is on a practically normal diet except that he is careful to omit condiments and keep roughage at a minimum. Since his last x ray examination he has had one moderately severe attack similar to those previously described, which kept him confined to bed for about four days. It

is of interest to note that he is wont to have a bit of food shortly before retiring and that all of the more severe attacks have occurred about one-half hour after he had gone to bed

PATHOGENESIS

The origin of duodenal diverticula is still a controversial issue that need not be entered into here. There seem to be valid arguments for either an acquired or a congenital origin. The question of chief interest in the present case is what changes take place, and under what conditions, to produce ulceration in the diverticulum.

The outstanding factor in the production of peptic ulcer is the proteolytic action of the gastric secretion upon an area of mucous membrane whose vitality has already been lowered, as by interference with its blood supply or direct trauma. That this action is related to the acidity of the gastric juices is strongly suggested by the anatomical distribution of duodenal ulcers, but such a factor can be of little significance in the production of ulcers beyond the second portion of the duodenum.

It is conceivable that small islets of aberrant gastric mucosa, whose glands function in a manner identical with those located normally in the stomach, might play a role, elaborating digestive ferments in normal or excessive amounts. Gastric heteroplasia is said by Ehrenpreis (2) to occur in about 12 per cent of Meckel's diverticula, and in such cases peptic ulcers have frequently been found (3). Superficial heterotopia of gastric glands in the small intestine is, however, of sufficient rarity (4, 5) to eliminate it as a likely cause of ulceration in a duodenal diverticulum. There is, furthermore, no record of the association of such ectopic tissue with a primary ulcer of either the ileum or jejunum (1b).

In a series of 47 primary jejunal ulcers collected from the literature by Ebeling (6), the majority were found to be located opposite the attachment of the mesentery, an area where the caliber of the vessels encircling the bowel is greatly reduced. This observation would seem to favor the theory of circulatory impairment as a

primary cause of this type of ulcer. In view of the structure of diverticula, it does not seem unreasonable that similar areas of vascular insufficiency might occur within their walls, especially if the diverticula are of considerable size. Such vascular impairment would furnish a predisposing factor, while retention of food—more especially, large quantities of roughage—would act as an effective irritant. The normal reparative process in lesions thus provoked in the mucosa would be hampered and the tendency to ulcer formation enhanced.

DISCUSSION

It is well known that diverticula arising from the third and fourth portions of the duodenum often fail to fill with the opaque medium with the patient in an upright position, and are therefore unobserved during fluoroscopy if this position only is used. In the case recorded here, at the first examination, fluoroscopic study was limited to the upright position, following which the usual prone and oblique films were obtained in the horizontal position. Although the entire duodenal sweep was seen on the fluoroscopic screen, the diverticulum was not visualized. There was definite epigastric tenderness, but this could not be precisely localized to the region of the duodenal bulb. When the wet films were viewed, the diverticulum, containing the ulcer crater, was observed for the first time.

Failure to demonstrate on routine films a lesion which was seen fluoroscopically is not uncommon. This only emphasizes the fact that we cannot depend upon films alone for information about diverticula, but must subject them to the same scrutiny with which other parts of the alimentary tract are examined. The use of palpation is essential where this procedure is anatomically possible. Fortunately, in the case reported, the lesion was visible on the routine films (Fig 1).

In the second examination (Fig 2, A), fluoroscopy was done in both the upright and horizontal positions, and tenderness,

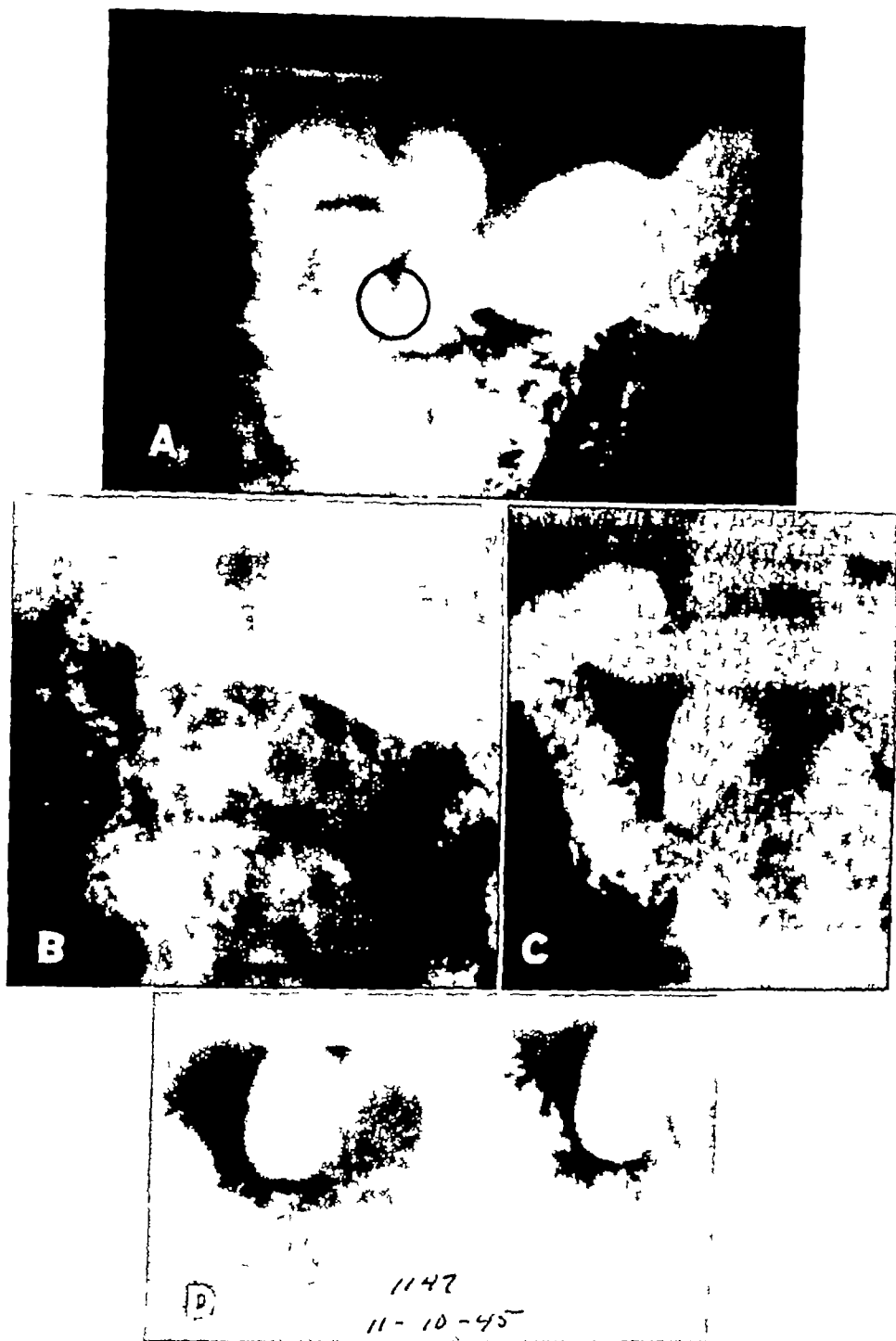


Fig 2 Second and third examinations A. Crater still present thirteen days later but induration and edema have disappeared B C D Ulcer apparently healed eight months later No sign of a crater

which was less at this time, was definitely located over the ulcer crater. At this examination the induration and edema at the margins of the ulcer, as seen in Fig 1, A, were no longer present, although the crater was still demonstrable. These findings, the diminution in tenderness, and absence of retention in the crater after four hours were interpreted as indicating a lessening of the inflammatory reaction and a tendency toward healing. A follow-up examination approximately eight months later showed no sign of an ulcer crater on conventional films (Figs 2, B and C) or spot films for which pressure was used (Fig 2, D). Although there was some generalized soreness in the epigastrium, no localizing tenderness could be elicited over the diverticulum. The author believes that these findings are satisfactory radiological evidence that the lesion has healed and prove its benignancy.

From the clinician's point of view, this case establishes another possible source of intestinal bleeding. Not uncommonly patients are referred to the roentgenologist for a gastro-intestinal study because of a secondary anemia and the presence of occult blood in the stool. There are always a few such cases in which the examination reveals no intrinsic disease, possibly because the lesion is too minute. Some examinations may prove entirely negative except for an isolated duodenal diverticulum. Because such a lesion is prone

to be a silent one, little significance is attached to it. The fact remains, however, that if an ulcer can develop within such a defect, it is capable of bleeding. If the lesion is small and remains hidden by barium, it can be readily understood how it may defy detection.

SUMMARY

1 A case of benign ulceration within a duodenal diverticulum is reported.

2 The pathogenesis of the lesion is discussed.

3 The use of palpation with the patient in a horizontal position is stressed as a vital part of radiological examination of the gastro-intestinal tract.

4 The clinical significance of such a lesion is mentioned.

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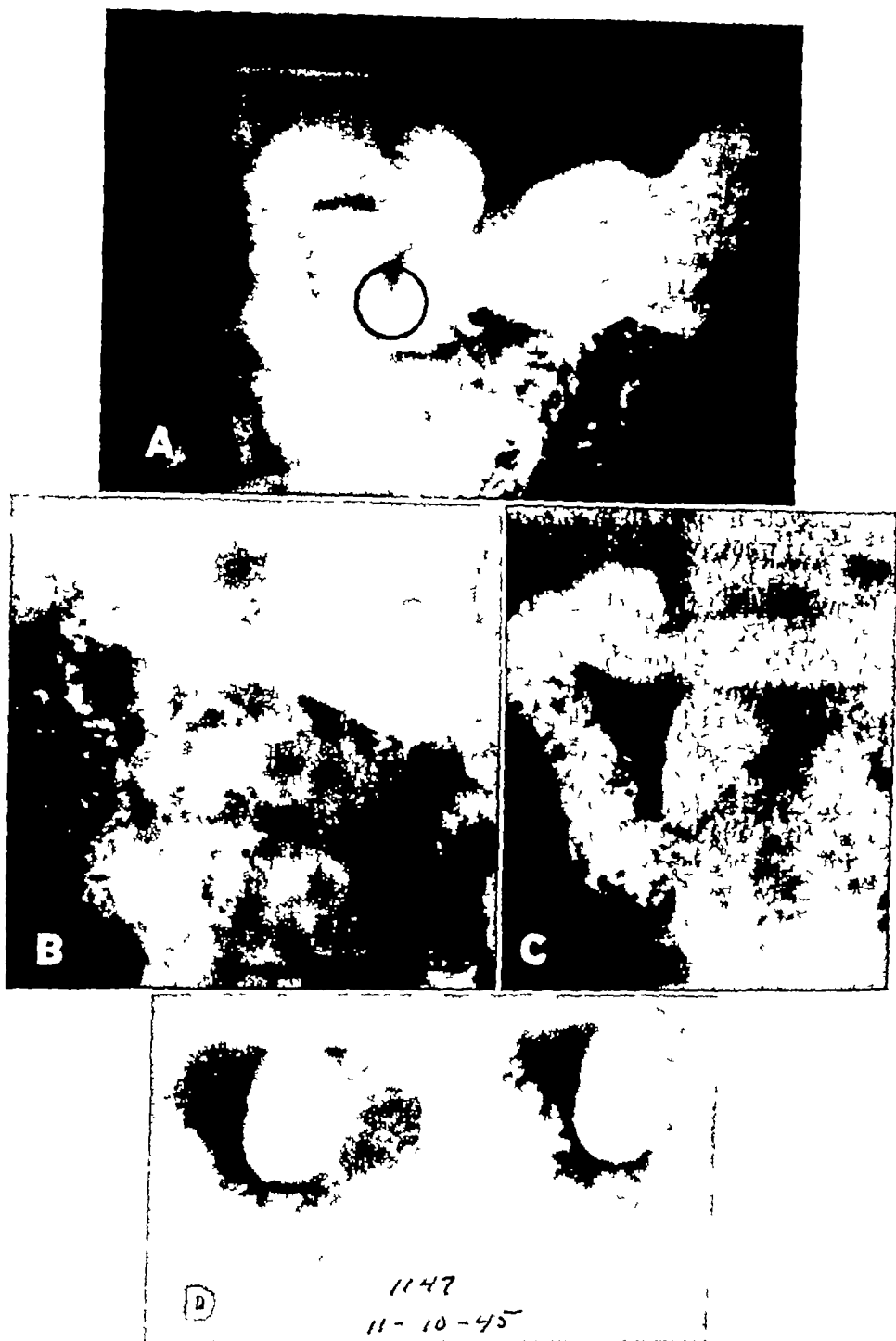


Fig 2 Second and third examinations A Crater still present thirteen days later but induration and edema have disappeared B C D Ulcer apparently healed eight months later No sign of a crater



Fig 1 A Fibrin exudate (A) in deep layers of connective tissue at time of fibrinous reaction Note large nuclei (B) absence of nuclear staining, and muscle fibers in Zenker's degeneration (C) Hematoxylin-eosin $\times 150$
 B Fatty degeneration of connective tissue cells at time of fibrinous reaction
 A Fat droplets Hematoxylin-Sudan III gelatin embedding $\times 70$

are completely obliterated, especially in areas of atrophy and sclerosis of connective tissue. It is remarkable that veins are more extensively changed than arteries. This may be a possible explanation of the ubiquitous development of edema. It is found in all possible locations in the larynx, often where inflammatory and

circulatory edema do not occur, and occasionally even in deep connective tissue between muscle bundles. Microscopically, one sees wide tissue spaces often filled with a coagulated eosinophilic (albuminous) material. In some instances, capillary blood vessels are markedly widened (Fig 4) in the environment of edema. Large

Reactions of Connective Tissues After Protracted Fractionated Irradiation of Laryngeal Carcinoma¹

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WITH INCREASING experience in protracted fractionated irradiation, it has been thought that one of the advantages of this method is that the connective stroma remains functionally and also morphologically almost unaltered, and that this is responsible to a large extent for the improved radiation effects. Clinical observations, however, of the fibrin reaction of the mucous membrane in the early stages of protracted fractionated irradiation, and of the atrophy, sclerosis, edema, and necrosis of connective tissue in later stages, are contradictory to this view. Thus it seems justified to describe microscopic findings on the connective tissue observed in the larynx one to ten months after protracted fractionated irradiation.

At the time of fibrinous epithelitis, the connective tissue is definitely altered. Absence or irregularity of nuclear staining, large nuclei, vacuolization of the cytoplasm, and fatty degeneration are exhibited microscopically. In this stage, various amounts of fibrin are present in the subepithelial and deep connective-tissue layers (Fig 1). The changes are less advanced than those in the epithelial cells, which are completely disintegrated at the time of the fibrinous radiomucositis.

One to two months after irradiation, the most frequent change in the connective tissue is a fibrinoid necrosis. This is best demonstrable with Weigert fibrin stains. With ordinary methods of staining, it is not recognizable as such. In some cases, one may later observe transition of areas of fibrinoid necrosis into colliquation, and spotty disintegration of the involved structures. On the other hand, a transformation into hyaline sclerotic scar tissue is often

seen. In the latter cases, the entire lamina propria of the larynx becomes atrophic to such an extent that the glands seem to be located immediately below the regenerated epithelium, due to the atrophy of connective layers (Fig 2). The elastic fibers lie close to each other in such conditions.

Necrotic areas of the connective tissue are located chiefly in the internal layer, near the lumen. This suggests that, in addition to the direct effects of radiation, there may be secondary accidents precipitating retrogressive connective-tissue changes. The almost constant finding of fusiform bacilli and of gram-positive cocci in disintegrated connective tissue indicates that secondary infections progressing from the lumen may play an important role in the development of such changes. The boundaries of the necrotic areas often display characteristic retrogressive nuclear changes and also a mild lymphoid cellular reaction. After more intense irradiation, lymphoid cells may be absent, the boundaries of the necrotic areas being marked only by a zone of nuclei in all stages of karyorrhexis, pyknosis, and karyolysis.

Areas of the larynx previously occupied by the tumor are replaced by hyaline scar tissue (Fig 3), consisting of homogeneous intercellular collagen with very few cells, blood vessels, and elastic fibers. The scar tissue is located mostly below the epithelial layers and extends in the shape of a funnel into the deep parts of the larynx. The regenerated epithelium covering the scar is flat.

Changes in the blood vessels are most marked nearest the lumen. They include capillary ectasia and dilatation of small arteries and veins. Some blood vessels

¹ From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. Accepted for publication in June 1946.

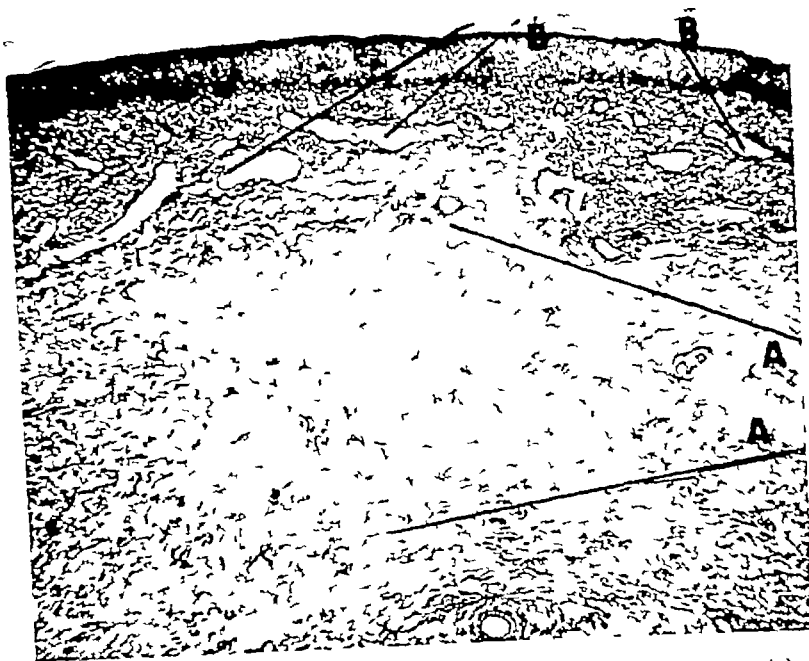


Fig 4 Submucous edema with dissociation of connective fibers (A), widening of capillary blood vessels (B) Hematoxylin eosin $\times 150$



Fig 5 Disintegration of myelinic sheaths Characteristic myelin droplets (A) Spielmeier stain $\times 250$

with disintegration of the myelin and characteristic precipitation of lipid droplets (Fig 5) Elastic fibers often appear in irregular groups, frequently they disintegrate completely They are also changed in elastic cartilages In areas of atrophy, thinning of the subepithelial connective

tissue—condensation of the elastic fibers—is shown without much actual loss of the latter Scars replacing disintegrating tumor tissue do not contain elastic fibers

The perichondrium (Fig 6) is characterized by a selective radiosensitivity



Fig 2 Atrophy of subepithelial connective tissue indicated by proximity of large laryngeal glands (A) and of elastic tissue (B) Weigert's elastin lithium carmine stain $\times 50$

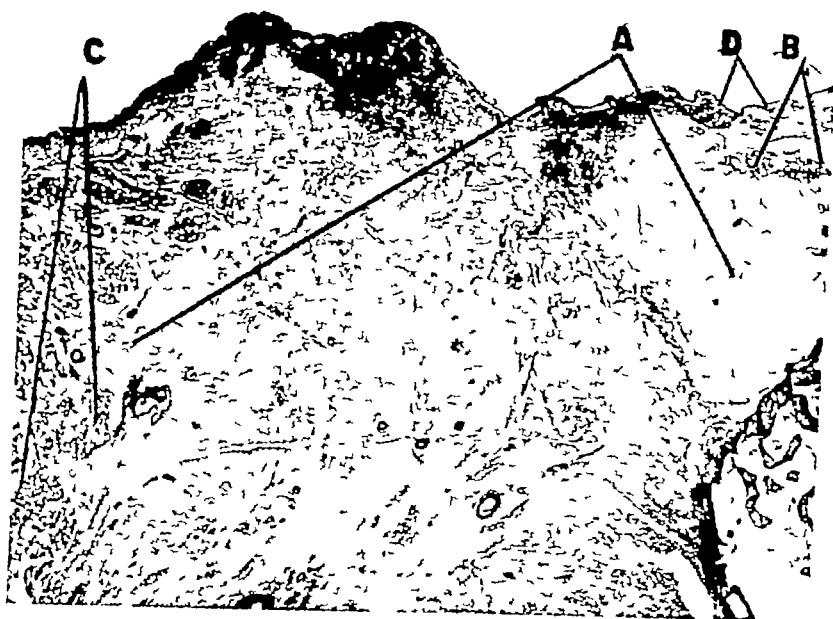


Fig 3 Area occupied by tumor tissue before irradiation filled with hyaline sclerotic connective tissue (A) atrophy of glands within hyaline scars (B) normal appearing glandular tissue (C) Note atrophy of epithelium above scar tissue (D) Hematoxylin eosin $\times 50$

vacuoles are present in the protoplasm of connective-tissue cells and many of them are isolated and surrounded by larger tissue spaces

Muscles, fat tissue, and nerves show various abnormalities. Atrophy of muscle fibers with marked increase of connective tissue between them and also Zenker's degeneration are common findings near the lumen. Large multinucleated giant cells are found, indicating a tendency of

muscles to regenerate. Small isolated groups of fat cells surrounded by an increased amount of connective fibers and atrophy of the cytoplasm are considered to be effects of radiation. In such cell groups, sudanophilia is decreased and the cytoplasm reveals honeycomb structures.

Advanced changes in nervous tissues are occasionally noticed. Stains of frozen sections prepared after the method of Spielmeyer show irregular myelin sheaths

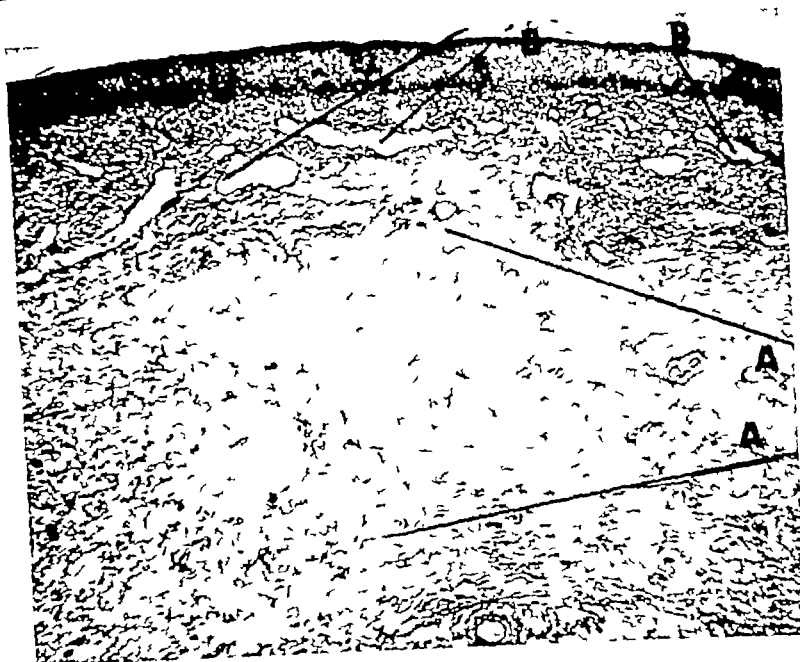


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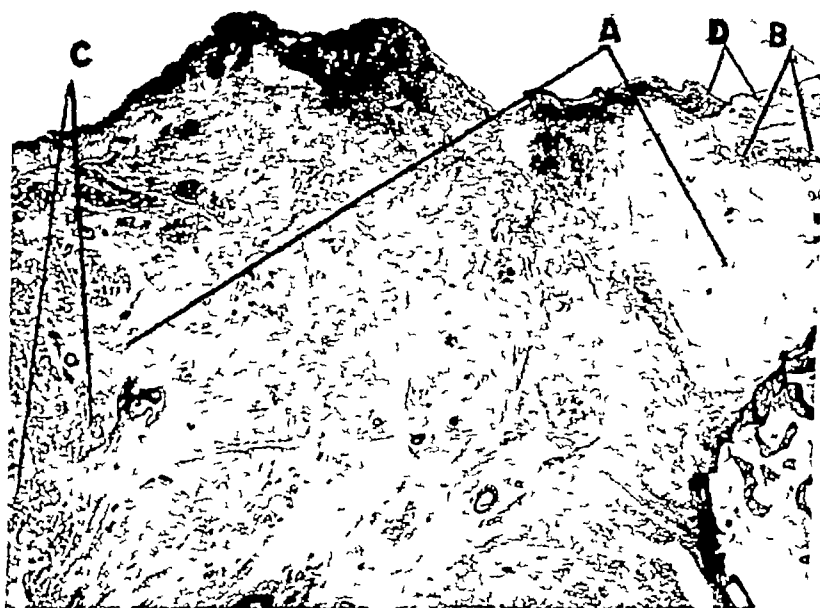


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Fig 7 Large abscess cavity (A) in surrounding of ossified cartilage (B) communicating by fistulous duct (C) with inner surface of larynx. Inflammatory cells are almost completely absent in wall of cavity. Hematoxylin eosin $\times 50$

This is probably due to its specific vascularization. The blood vessels around the cartilage form an almost closed system of arteries and veins which have very few collaterals communicating with the vessels of adjacent structures (Schumacher). At the time of the fibrinous reaction, isolated fibrin exudate can occasionally be seen in the perichondrium. Later, obliterative vascular changes become evident. These are often associated with fatty degeneration of the perichondrium itself. The degenerated tissue seems to be more susceptible to infections than adjacent structures. Consequently, a selective infiltration of the perichondrium by inflammatory cells is a common finding in early post-irradiation conditions. These changes are followed later by more or less extensive tissue disintegration. Abscess cavities are formed around the cartilage or bone tissue. They may break through to the inner surface of the larynx, producing fistulous ducts or larger necrotic areas (Fig 7).

As a rule, the system of bone and periosteum shows a greater resistance to irradiation than the cartilage and perichondrium. Retrogressive changes developing in the

perichondrium and adjacent tissues often stop in the area of transition. Bone marrow, if present, is usually atrophic, in one case (6,500 r), however, examined six months after the last irradiation, functioning hematopoietic parenchyma was exhibited.

Inflammatory reactions are remarkably reduced. Often, cellular reactions are absent in the environment of necrotic or necrobiotic areas. In many instances, superficial ulcerations or deep perichondritic abscesses show disintegration of the connective tissue without cellular reactions in their surroundings. In certain cases, it appears that the resisting power of the connective tissue against the progress of bacterial invasion is almost entirely absent. Acute retrogressive changes progress without a noticeable sign of tissue defense. The few inflammatory cells found are mostly small lymphocytes. At times, a few plasma cells and also polymorphonuclears are present around deeper layers of necrotic areas.

In order to study inflammatory reactions of irradiated connective tissue after protracted fractionated irradiation, the follow-

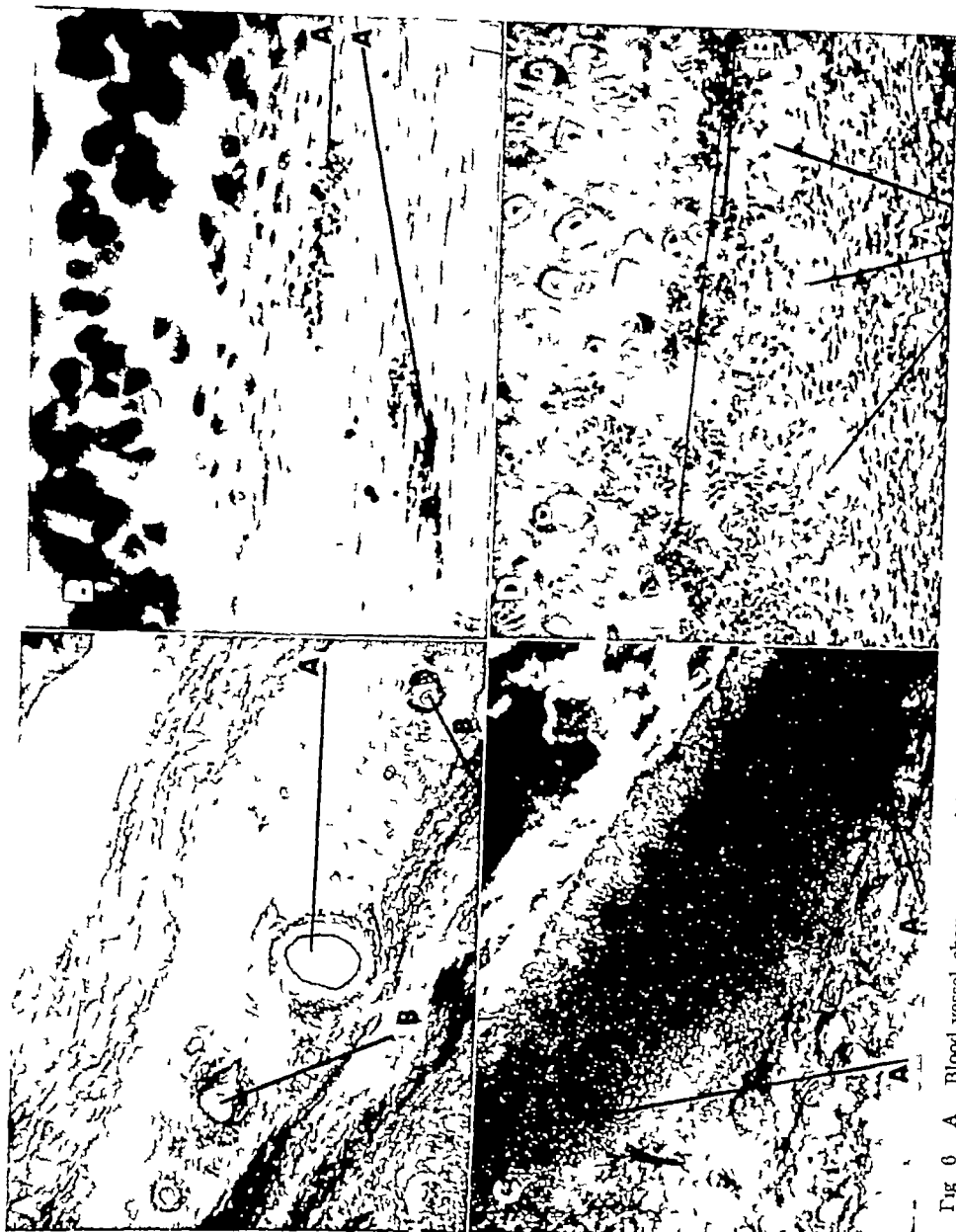


Fig 6 A Blood vessel changes in perichondrium Middle sized artery (A) shows free lumen Veins (b) are partly obliterated by productive endophlebitis Retracted cartilage in right upper portion of picture Weigert's elastin stain X 70 B Fat droplets in perichondrium (A) Hematoxylin Sudan III X 500 C Fibrin exudate in perichondrium (A) at time of fibrous reaction Retracted cartilage in right upper corner of picture Hematoxylin-eosin X 70 D Inflammatory cell reaction in hyaline perichondrium (A) Lymphocytes (b) infiltrate the superficial layers of the cartilage itself Hematoxylin eosin X 250

and fibrin exudate in the vicinity of tissue necrosis, remarkably few inflammatory cells, mainly lymphocytes, were present. The deep layers of subcutaneous connective tissue were dense and somewhat sclerotic. In control animals there was a broad layer of polymorphonuclear leukocytes with serofibrinous exudate in the vicinity of the abscess, and no connective-tissue changes were displayed. Abscesses in irradiated animals healed in seventeen days, those of control animals eight days after injection.

COMMENTS

Microscopic studies show that, contrary to general belief, there are profound and extensive early and late changes in the connective tissue after protracted fractionated irradiation of the larynx. It seems that the changes are primarily and principally the same as those which are known to appear after simple irradiation, not protracted. The basic difference is that, with a similar x-ray dose without fractionation, the connective tissue changes are more advanced and are irreversible, resulting in total destruction of the irradiated areas. The alterations in the connective structures after protracted fractionated irradiation are reversible, however, the microscopic appearance and function of newly formed connective tissue with regard to inflammatory reactions are different from those in unirradiated tissue. This can be proved in animal experiments.

Examination of a large number of microscopic slides reveals that after a balanced course of irradiation, without demonstrable interference of bacterial infections, the characteristic condition of regenerated connective tissue is that of a hyaline sclerosis. This is associated with a diffuse atrophy of the areas involved. Cancer tissue surrounded by hyaline sclerotic connective tissue exhibits advanced disintegration, while that surrounded by loose connective-tissue layers shows various degrees of retrogressive change. It does not disintegrate as completely as if it were surrounded by hyaline scars. Not only cancer cells enclosed in areas of sclerotic atrophy, but

also laryngeal glands, muscles, and fat tissue become atrophic. Blood vessels are often obliterated under such conditions.

During the past years, it has become the general opinion that the trophic effects of irradiation on the connective tissue are to a large extent responsible for the disintegration of the tumor cells. It has been pointed out that certain forms of cancer might be destroyed by trophic influences of the connective tissues alone. Maximal effect can be expected if the loose normal connective tissue becomes transformed into hyaline structures. This transformation is evidently more successfully induced by fractionation of the dose for a long period of time than by expeditive methods of irradiation. There is no doubt that the hyaline sclerotic connective tissue with its few cells and blood vessels is not only morphologically but also functionally an entirely different tissue from the lamellar, loose connective layers of the *membrana propria* of the larynx. The structural and probably also the functional changes develop after regeneration of the connective tissue following irradiation damage. Since these newly formed connective structures are under the influence of radiation during retrogression as well as during regeneration, they must be more radioresistant than the normal connective tissue (Regaud), otherwise, their regeneration during irradiation could not occur.

There are indications that the beginning of the hyaline sclerosis of the connective tissue is coincidental with the resorption of the fibrin exudate from intercellular spaces. In our series of examinations, this was indicated in one case only, but in four other cases it could be demonstrated that there is a certain *relation between the extent and intensity of the clinical fibrinous radiomucositis and extent of development of the hyaline sclerotic connective tissue*. A complete series of examination materials were not at the writer's disposal, so that the question of whether the development of a hyaline sclerosis is in some way indicated by the differences in quality and quantity of the fibrinous radiomucositis, could not be defi-



Fig 8 A Subcutaneous turpentine abscess in non irradiated guinea pig Note extensive cellular infiltrate in environment of tissue necrosis (A) Hematoxylin eosin $\times 150$ B Subcutaneous turpentine abscess in irradiated guinea pig Note few inflammatory cells in environment of tissue necrosis (A) Connective tissue partly hyalinized Hematoxylin-eosin $\times 150$

ing series of experiments was performed. The right inguinal areas of three guinea-pigs of equal weight were irradiated, the physical factors being as follows: field 2×2 cm, skin-target distance, 30 cm, skin dose, 4,500 r, 180 kv, Thoraeus filter, 15 r per min, 150 r daily. On the first day after the last irradiation, 0.02 cm of turpentine was injected subcutaneously into

the irradiated areas. On the same day, the same amount of turpentine was injected into corresponding areas in three non-irradiated guinea-pigs of the same weight. Four days later, sterile abscesses appeared in both series of animals at the injection sites (Fig 8).

Microscopically, the abscesses in the irradiated animals revealed a marked edema

The Biological Significance of Fibrinous Radiomucositis of the Larynx¹

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SINCE THE FIRST description of fibrinous radiomucositis of the oropharynx and larynx, the significance of this phenomenon has often been in the foreground of discussions but has never been definitely evaluated. Investigators have been inclined to believe that this reaction may be considered as a clinical test indicating radiobiological changes in the irradiated tumor. The time of appearance and the extent of fibrinous exudate formation are widely used as an indicator for the amount and distribution of radiation in the therapy of tumors of the oropharynx, nasopharynx, and larynx.

It has been pointed out that the appearance of an extensive and confluent radiomucositis indicates that the dose necessary to destroy tumor cells has been reached. On the other hand, the necessity of the production of a confluent radiomucositis in order to achieve a favorable therapeutic result has been doubted. Borak emphasized that if the applied dose does not induce radiomucositis, or provokes only a mild degree thereof, regression of the tumor will be temporary and incomplete. As a rule, in such cases recurrence may be expected in about a year and permanent cure is the exception.

I have studied a number of larynges (autopsy specimens) microscopically at or near the height of fibrinous radiomucositis. The epithelium is gone. The fibrin lies on what I take to be the old *membrana propria*. It also dips into the ducts of mucous glands, the acini of which are distended by basophilic material (retained secretion). Large amounts of fibrin are present in the subepithelial connective tissue and also in laryngeal muscles and in the perichondrium. This is a constant finding in the

presence of clinically observed fibrinous mucositis and had persisted in one case for two months after the last irradiation. In cases in which fibrinous radiomucositis did not occur, only small amounts of fibrin or fibrinoid were noted in the connective tissue (4 specimens).

Since standard irradiation technic was used, we must assume that the variation in degree of fibrinous exudate formation was due to constitutional differences prevailing in the tissues of the larynx itself. The larynx seems to react to irradiation in the same manner as it does to bacterial, chemical, or thermal influences. These, too, often induce the development of strong fibrinous pseudomembranes. At times, however, this reaction fails to occur, despite exposure to the same pathological stimuli.

Microscopic examination conclusively shows that superficial and deep fibrinous exudation is not a reaction of tumor cells or tumor structures, as has been assumed. It is a reaction of connective tissues and blood vessels. As Lubarsch pointed out, development of fibrinous membranes always follows necrosis of epithelial cells. Hirschfeld believes, however, that the first step in the course of development of fibrinous membranes is fibrin exudate formation. In his observations, fibrin accumulated below the epithelium, and this became necrotic secondarily. The fibrin then coagulated, covering the defect caused by the epithelial necrosis. At the same time, the subepithelial connective-tissue spaces became saturated by masses of exudate, which again coagulated in the presence of necrotic cell structures. In such cases the collagenous fibers exhibited a positive biochemical fibrin reaction. Ac-

¹ From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. The second of a series of four papers accepted for publication in June 1946.

nitely decided in the present studies. If, however, clinical experience shows that there exists a relationship between the effects of irradiation upon the tumor on the one side and the appearance and intensity of the fibrin exudate on the other, it would be worth while investigating whether or not the differences in the fibrin reaction indicate that a more or less extensive hyaline metamorphosis of the connective tissue is to be expected and, in connection with it, a more or less extensive retrogression of the tumor.

SUMMARY

Three stages may be observed in the connective-tissue changes following protracted fractionated irradiation of the larynx.

The *first* is a bionegative, retrogressive period characterized by exudation of fibrin, loss of nuclear staining, and frequent changes in the microchemical reaction of subepithelial collagenous fibers. This period is coincidental with the fibrinous radiomucositis and disintegration of the epithelial cells of the mucous membrane.

The *second* period might be called a biopositive regenerative period. Connective tissue fills out the spaces remaining after disintegration of the tumor. The retrogressively changed fibrinoid necrotic collagen of the lamina propria is replaced by hyaline sclerotic layers. Myogenous giant cells indicate the regenerative tendencies of these tissues. Inflammatory reactions of the regenerated connective tissue are markedly reduced as a specific effect of radiation on this structure. This has been shown not only on human tissues but also in animal experiments. Damaged endothelium of blood vessels reacts with connective-tissue proliferation, causing obliterative changes.

A *third*, retrogressive, period may be

expected in cases which have been improperly irradiated or in which the individual sensitivity of the connective tissue is higher than average. In such cases, the newly formed connective tissue becomes necrotic, the mucous membrane shows ulcerations, and secondary bacterial infections develop and progress into deep layers of the irradiated larynx.

The histologic changes following fractionated protracted irradiation differ from those present after single or expedite methods of irradiation. Retrogressive and regenerative conditions develop under the influence of a continuous flow of the radiant energy. It is therefore reasonable to assume that such connective tissue becomes more resistant to the irradiation and probably will not disintegrate if increasing doses are delivered in the course of protracted fractionated irradiation.

The probable relationship between fibrin exudation, development of fibrinoid necrosis, and its replacement by hyaline sclerotic connective tissue are discussed in detail. The result of this is a profound change of the general nutritive conditions of the larynx, mainly in areas near the lumen. The development of perichondritis and edema is also influenced by vascular changes.

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Fig 3 A 71-year-old man had cancer of the left vocal cord and left aryepiglottic area extending below the cord (squamous-cell cancer, Grade 2). Total tissue dose 5340 r, 4.3 r/min. Thoraeus filter, 200 kv. Clinically a mild fibrinous reaction started on the twentieth day and disappeared on the twenty eighth.

Microscopic examination six and a half months after the last day of irradiation showed epithelium regenerated thick epidermoid (A). subepithelial tissue retrogressively changed exhibiting a strong fibrin reaction (B). Fibrin stain according to Weigert $\times 150$.

cording to Marchand, this explains the development of so-called fibrinoid necrosis.

Clinical observation of irradiated patients gives the impression, however, that radionecrosis of the epithelium always precedes the development of fibrinous membranes. If fractionated irradiation is used, the disintegration of epithelial cells depends exclusively upon the dose received. In the absence of fibrinous reaction, epithelial radionecrosis may be recognized clinically by the presence of deep local hyperemia with loss of surface glossiness.

The fibrin is not produced by epithelial cells but by the reaction of the connective tissue and capillary blood vessels under the epithelium or after they are denuded of epithelium. Thus, it is the mirror of the connective-tissue response to irradiation. Even if fibrinous membranes are located above tumor tissue, they do not come from the tumor cells but from the supporting interstitium between the cells.

Epithelial cells, either normal or cancerous, are unable to produce fibrin. Whenever differences are observed in the time of appearance, intensity, and location of fibrinous radiomucositis, they are indicative of variations in reaction of connective and vascular tissue and not of variations in direct radiosensitivity of tumor cells.

If, despite these facts, a definite clinical relationship has been established between the properties of the fibrinous membrane and the reactions of the tumor to irradiation, the only explanation can be that this relationship is based mainly on reaction of the connective and not of epithelial structures. It must also be emphasized that there is no microscopic evidence for the general belief that at the time fibrinous radiomucositis appears, the connective tissue is unchanged. Fibrin has already appeared in the subepithelial connective tissue when the epithelium first begins to disappear.

Before summarizing the significance of



Fig 1 A 60 year old man presented a flat, ulcerated cancer on the left parietal portion of the epiglottis (squamous-cell carcinoma Grade 2). Total tissue dose 7760 r 43 r/min two fields each 6 X 5 cm Thoraeus filter, 200 kv. Clinically, radioepithelitis was marked, starting on the thirteenth day and still present on the twenty eighth day, when the patient suddenly died.

Gross local findings: Flat ulcerations on vocal cords. Right side of epiglottis shrunken. Inside of larynx and both piriform sinuses covered with greenish gray fibrinous membranes easily identified with those seen clinically during irradiation. Area previously involved by tumor now filled with fibrous scar tissue.

Microscopic findings: Epithelial cells destroyed. Thick fibrinous membrane (A) above membrana propria (B) replacing epithelial tissue. Significantly very few leukocytes were present in and below the fibrinous membrane. Van Gieson stain X 250.

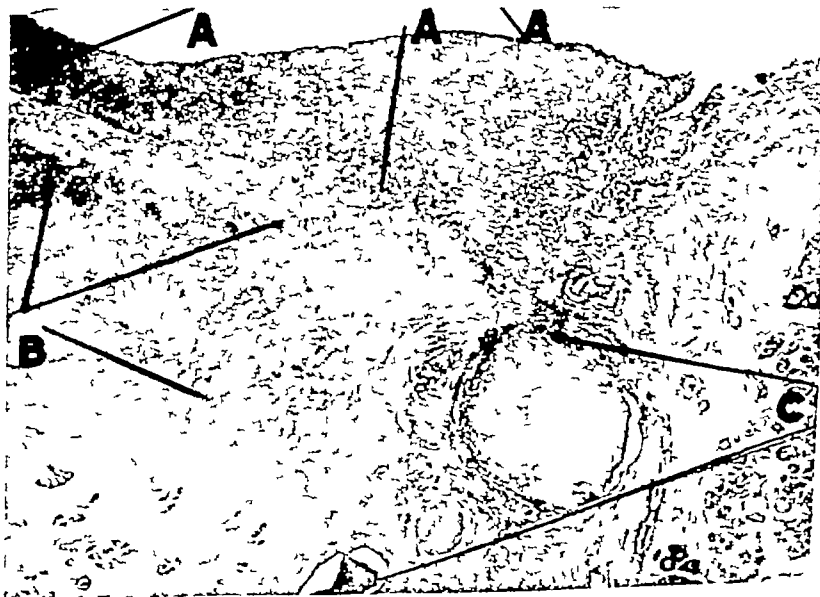


Fig 2 Same case as Fig 1. Superficial fibrin masses (A) dip into ducts of mucous glands. Large amounts of fibrin are present in the subepithelial connective tissue (B). Ducts are dilated (C). Hematoxylin eosin X 70.

Latex Cap for Radon Ointment Treatment¹

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IN THE FALL OF 1943 the section of Oro-Facial Prosthesis, College of Dentistry, University of California, was asked by Dr B V A Low-Beer, of the Department of Radiology, University of California Medical School, to solve the problem of fabricating latex caps that would fit over any surface of the body to confine air-tight applications of radon ointment

A technic was developed and latex caps were made to meet the following prerequisites

- (a) Periphery of cap must be in perfect apposition to the tissue, regardless of anatomical contour
- (b) There must be no contact between the cap and the lesion proper
- (c) The cap must be securely held in place, the periphery sealed air-tight with liquid adhesive instead of adhesive tape
- (d) The cap must be light, semiflexible, and sterilizable
- (e) The cap must have tissue tolerance

The method previously used was the placement of a piece of rubber dam over the lesion, the periphery being sealed with adhesive tape. The disadvantages of this method were

- (a) The frequent inability to seal the periphery airtight
- (b) Irritation and annoyance from the use of adhesive tape
- (c) Pressure on the lesion
- (d) Inability to accurately follow anatomical configuration

To meet the predetermined requirements and avoid the difficulties formerly met, the most obvious approach is to have an accurate impression of the area under con-



Fig 1 Radiation ulcer, right ear

sideration. Proceeding with this in mind, the following steps are taken

- (a) Place the patient in a comfortable position on a table or a gurney with the area of which the impression is required in a horizontal position. The area of the lesion to be covered by the cap is determined and outlined with indelible pencil by the physician. An accurate impression is taken with a suitable material, such as alginate, colloid, or plaster of paris, and extended at least 1.0 cm beyond the outline
- (b) Pour a positive model from the impression in stone or plaster of paris. This cast with the peripheral margin transferred will be a perfect replica of the area under

¹ From the Section of Oro-Facial Prosthesis, College of Dentistry, University of California, San Francisco, Calif. Accepted for publication in April 1946.

radiomucositis, the following considerations must be reviewed

1 Doses of radiation sufficient to destroy the epithelium always produce fibrinous mucositis provided that there is a constitutional capacity of the connective tissue of the larynx to produce fibrin in the actual case

2 Radionecrosis of epithelial tissue may be present in the absence of fibrinous radiomucositis

3 Strong radiomucositis is not a sign of increased sensitivity of the epithelium or the cancer. It merely indicates increased constitutional ability of laryngeal tissue in a particular case to produce fibrinous exudate

4 Delay or absence of radiomucositis with standard dosage does not necessarily mean that the cancer is not radiosensitive. It signifies inability or a low degree of ability of the connective tissue to produce fibrin

5 The early appearance of radiomucositis, however, is a sign of early disintegration of the epithelial cells and an early reaction of the connective tissue to radiant energy. Such reaction holds promise that cure will be attained

6 These relations are the same, whether the radiomucositis is localized above the tumor or in more distant areas of the oropharynx

Clinical experience shows that if fibrinous radiomucositis appears early or intensively, retrogression is more rapid and complete than in cases in which this reaction is weak or delayed. It also seems that within certain limits there is a more definite interrelation between the intensity of radiomucositis and disappearance of the tumor than between the amount of radiation applied and the curative effect of the treatment. Occasionally, pronounced radiomucositis appears after the application of a relatively small dose. Consequently, if clinical experience proves a relationship

between shrinkage of the tumor and the properties of radiomucositis, in view of the connective-vascular nature of this reaction, we must conclude the following

1 Connective-vascular tissue participates notably in the complex of reactions connected with tumor retrogression provoked by irradiation

2 Radiomucositis and its properties are indicative of the degree and extent of connective-tissue reaction

3 The more marked and earlier the connective-tissue reaction, the more it contributes to the success of radiation therapy

4 Delay or absence of connective-tissue reaction is associated with a clinically less favorable effect of irradiation

Consequently, if we evaluate the clinical aspects of radiation therapy of laryngeal carcinomas from the properties of radiomucositis in a particular case, we estimate the capacity of the connective tissue to participate favorably in radiobiological reactions, rather than the direct radiosensitivity of the cancer cells. It appears, also, that any physical variation in treatment which has as its purpose the promotion of vital reactions of the connective tissue, in addition to the primary destruction of tumor cells, promises optimal clinical results

The interaction between tumor and connective tissue as regards the significance of fibrinous reaction is not yet definitely established. It appears probable, however, that connective structures displaying strong fibrinous reactions are more likely to be transformed in the course of irradiation into a hyaline atrophic and fibrosclerotic condition than connective tissues which do not exhibit this property. The important role of nutritive influences of fibrosclerotic structures in retrogression of epithelial neoplasms is, however, an established fact

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consideration The cast, or model, is checked for accuracy, and any irregularities corrected (Fig 2)

- (c) Modify the model so as to have a space of 3.0 to 8.0 mm between the finished latex cap and the lesion proper This is accomplished by carefully placing several sheets of base plate wax over the area to be relieved (Fig 3)
- (d) Make an impression of this model with the wax onlay as if it were the patient, and pour a new cast This modified model relieves pressure over the lesion
- (e) Adapt base plate wax over the modified model, this time to be the pattern for the latex cap The thickness of the cap and reinforcement will vary from 2.0 to 8.0 mm, depending upon the size and the shape of the finished prosthesis Seal the periphery of this wax pattern to the modified model (Fig 4, A)
- (f) Box in the model with the wax pattern with ash metal or wax and pour a second half in plaster or stone (Fig 4, B)
- (g) Separate the halves and eliminate the wax, drill a sprue hole, and cut out a funnel-shaped hopper around the drilled hole, using the point nearest the model as the apex (Fig 5, A)
- (h) Clean and dry and reassemble the halves, holding them in place by adhesive tape or C clamps Pour the liquid latex into the funnel-shaped hopper, vibrate to eliminate all air bubbles, place over a radiator or in a hot air oven to cure for forty-eight hours (Fig 5, B)
- (i) Separate the halves after the latex is cured Cut the cap from the sprue, trim up, wash in soap and water, and thoroughly dry The finished latex cap is now ready for application on the patient (Fig 6)



Fig 7 Finished latex cap secured in place on patient

After the lesion is treated with radon ointment, the periphery and flange of the latex cap on the tissue side is covered with a liquid adhesive such as J & J, gum mastic, or Duco cement The cap is now settled into place and held securely until the cement has set The patient is dismissed until the next treatment After each treatment, the latex cap is removed, cleaned up, and made ready for as many cementations as needed (Fig 7)

SUMMARY

A process has been developed for the construction and application of a custom-made latex cap with a periphery capable of being sealed air-tight around a pre-determined area, without pressure on the lesion The cap is capable of being cleaned and sterilized for as many subsequent treatments as necessary and affords a minimum of discomfort and embarrassment to the patient

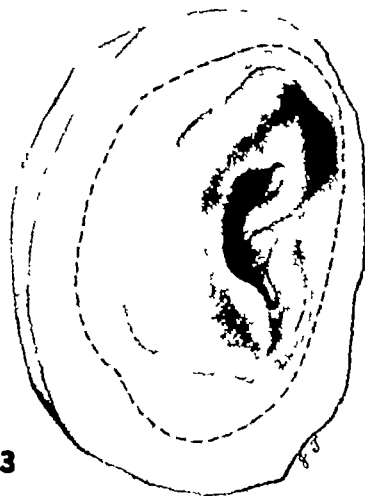
College of Dentistry University Hospital
San Francisco 22 Calif

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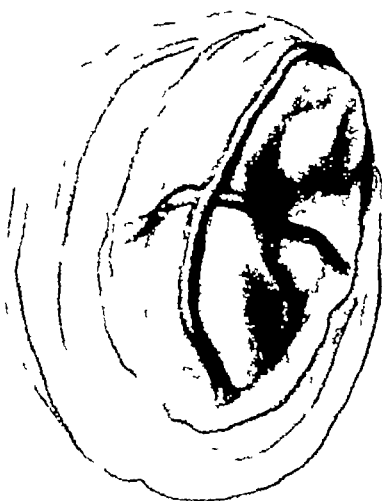
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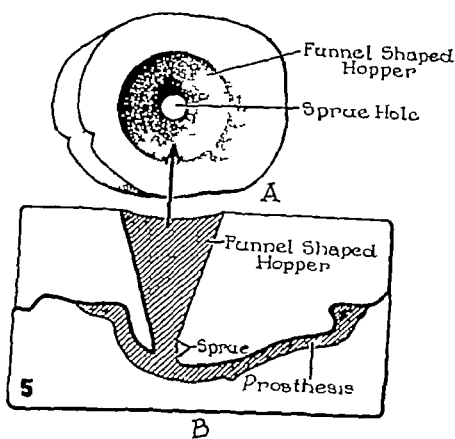


A

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B



5

B



6

Fig 2 Original model Fig 3 Original model modified to give a negative relief so there will be no contact between ulcer and latex cap Fig 4 Wax pattern formed on modified model (note reinforcing ribs) B Negative poured in plaster of paris on A Fig 5 A Plan view of Fig 4 A showing hopper and spruehole after wax is eliminated B Cross section of Fig 4 with A and B assembled Fig 6 External view of finished cap

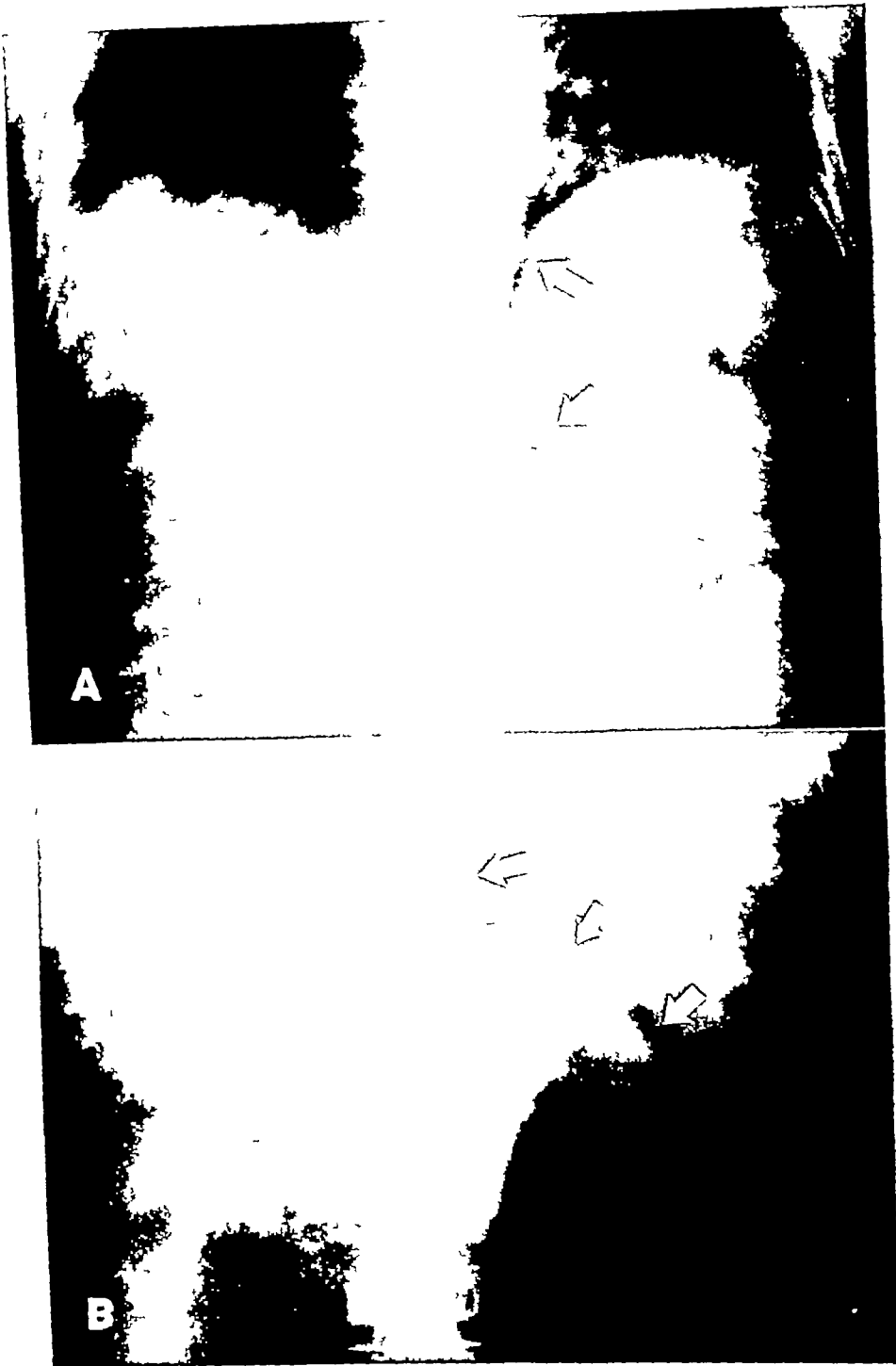


Fig 1 A Supine film of the upper abdomen made on the evening of admission (Oct 5 1945) Arrows point to the air extending along the crus of the left hemidiaphragm and between the peritoneum and the muscle layer of the diaphragm
 B Supine film of the upper abdomen made on the morning following the day of admission showing extension of the gas down over the superior pole of the left kidney

Retroperitoneal Perforation of the Duodenum

Report of a Case¹

E. C. KOENIG, M.D., and GORDON J. CULVER, M.D.

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A DISCUSSION OF retroperitoneal perforations, with a report of two cases, was published from this department in December 1944 (Jacobs, Culver, and Koenig). Since that time, a third case, diagnosed by roentgen examination and subsequently proved by surgical exploration, has been studied. A report of this third case is made to demonstrate further the validity of the x-ray findings which were discussed in the earlier article.

CASE REPORT

A 60-year-old obese Italian female was admitted to the hospital about 8:00 P.M., Oct. 5, 1945, complaining of nausea, vomiting, and severe right upper abdominal pain. She gave a history of abdominal distress, heartburn, and nausea for the past twenty years, with acute episodes once or twice each year. She had had a very severe attack about seven years previously, at which time she was in bed for three weeks and required morphine for relief of right upper quadrant pain. Indigestion had been worse than usual for two weeks prior to admission.

The present attack began two days before admission, with nausea, vomiting, and epigastric distention. The patient took both castor oil and enemata several times but obtained no relief of symptoms. About 5:00 A.M., on the day of admission, she was awakened by severe abdominal distress and a feeling of distention. She again took castor oil and an enema with no relief. She vomited at noon and slight temporary relief of symptoms ensued. At 5:00 P.M., there occurred a severe attack of right upper quadrant pain, which was still present when the patient entered the hospital.

On admission, the temperature was 100.2°, pulse 100, respirations 30, blood pressure 120/60. The abdomen was distended, with marked tenderness over the entire upper part. The tenderness was most severe in the epigastrium and right upper quadrant. No peristalsis was heard. Rales and decreased breath sounds were present throughout the bases of both lungs.

Blood findings were as follows: red cells 3,970,000, hemoglobin 90 per cent, white cells 20,800 (81

per cent polymorphonuclear cells with marked left shift), icteric index 5-10, bilirubin (van den Bergh reaction) 0.35 mg per 100 c.c., glucose 190 mg per 100 c.c., urea nitrogen 18 mg per 100 c.c., serum amylase 32. Urinalysis showed albumin 2 plus and glucose 4 plus.

On a plain film made on the night of admission the stomach did not appear to be greatly dilated, but the outline of the greater curvature seemed to lie low in the abdomen. A streak of gas extended along the left crus of the diaphragm and for a short distance along the medial portion of the left leaf. The distribution of the gas appeared to be retroperitoneal.

Further roentgen studies the next morning revealed a greatly distended stomach filled with fluid and gas. This was proved by instilling a small amount of barium through the decompression tube. The distended stomach depressed the transverse colon and a long fluid level was demonstrable with the patient in the right decubitus position. The retroperitoneal gas noted in the left upper abdomen on the previous night extended down over the superior pole of the left kidney.

From the roentgenographic findings it was concluded that the patient had a lesion at or near the pylorus, on the duodenal side, which had produced pyloric obstruction and had perforated retroperitoneally, resulting in the retroperitoneal distribution of air described above.

The patient's condition was unchanged the day following admission. The temperature remained elevated, the abdomen was still distended, and abdominal pain persisted. Treatment was conservative, with gastric decompression and morphine for relief of pain.

On the third day, the findings were essentially the same. On the fourth day, the patient was definitely worse. Her temperature was 103°, her lips were cyanotic, and rales were heard in the bases of both lungs. Gross blood was present in material from the gastric drainage. Roentgenograms taken on this day showed some lessening of gastric distention, with some barium remaining in the stomach after forty-eight hours. More gas was present in the colon and small intestine than on previous examinations. The diaphragm was elevated bilaterally, with moderate compression atelectasis at both lung bases. The air over the superior pole

¹ From the Department of Roentgenology, Buffalo General Hospital, Buffalo, N. Y. Accepted for publication in March 1946.

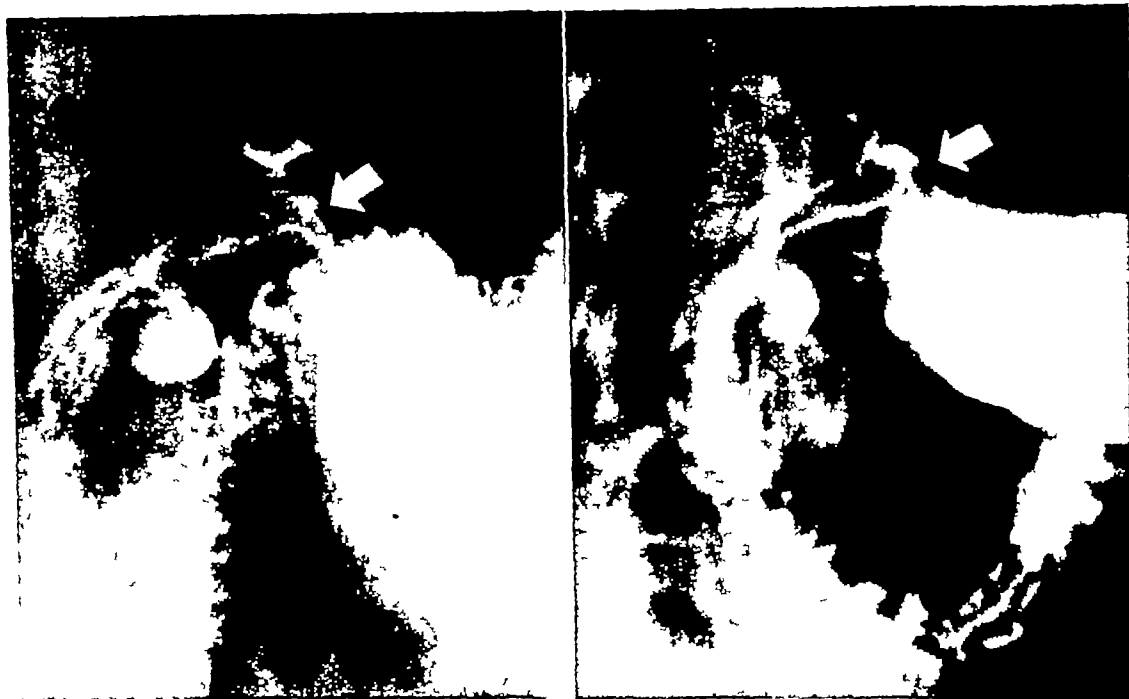


Fig 3 Films of the duodenum made Oct 19, 1945 prone and right anterior oblique projections showing the duodenal deformity with mucosa pulling in toward the area of ulceration in the posterior wall. The small diverticulum off the second portion of the duodenum is also well visualized.

as seen in the roentgenograms has been described.

3 This case is presented only as an added incentive for a more diligent search of plain films in acute abdominal episodes. A previous article considers the entire problem of retroperitoneal perforations.

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Buffalo General Hospital
Buffalo 3, N. Y.





Fig 2 Film of the abdomen made the same morning as that reproduced in Fig 1, B. A small amount of barium has been instilled through the decompression tube to outline the markedly dilated stomach.

of the left kidney and under the left diaphragm was still present but appeared to be diminished.

The condition remained about the same for the next seven days. The patient was treated conservatively with penicillin, gastric decompression and sedation. Her temperature remained elevated, but pain and tenderness subsided, and the abdomen became somewhat less distended. Physical signs persisted in the bases of both lungs.

X-ray examination on Oct 17 showed the gas bubble in the stomach to be of normal size. Oral cholecystography revealed a non functioning gall bladder. Further study of the stomach and duodenum, on Oct 19, showed a duodenal cap which was markedly deformed, with an ulcer crater the size of a match head, in the mid posterior wall. The deformity was sufficient to give the impression of an inflammatory mass surrounding the cap, probably secondary to a perforation. There was a small diverticulum off the medial aspect of the upper part of the second portion of the duodenum. At the end of four hours, the stomach was practically empty.

The patient continued to show abdominal distention, constipation, and daily spiking of temperature up to 102° . The surgical service, which had clung to a diagnosis of gallbladder disease with complications throughout most of the period of hospitalization, made a final diagnosis (Oct 20) of perforated ulcer of the posterior wall of the duodenum, with secondary subdiaphragmatic abscess.

On Oct 25, the abdomen was explored through an upper transverse incision. There were many fibrinous adhesions in the right upper quadrant involving the gallbladder, transverse colon, duodenum, and liver edge. The gallbladder had a thickened wall and contained several stones but was not involved in a recent acute process. The first portion of the duodenum was inflamed and indurated and was believed to be the site of a recent complicated ulcer. No attempt was made to break up adhesions about the duodenum for further exploration.

Upon separating the fibrinous adhesions between the right lobe of the liver and the parietal peritoneum, an abscess cavity was entered which lay between the convex surface of the right lobe of the liver and the diaphragm. About two ounces of serous fluid and many large plaques of lymph escaped. No pus was obtained. The abdomen was closed with a drain in the abscess cavity.

The postoperative course was smooth. Cultures from the abscess were sterile. The patient improved steadily and was discharged with no complaints on Nov 17, 1945. During her hospital stay, it was discovered that she had a mild diabetes mellitus, which was well controlled by diet.

DISCUSSION

In our original article we presented two cases of retroperitoneal perforation of the duodenum due to blunt trauma to the back. This third case seemed particularly interesting because it was due to an ulcer of the posterior duodenal wall. The distribution of retroperitoneal air was strikingly similar to that noted in one of the cases previously presented, as can readily be seen in the illustrations. This strengthens our previous contention that retroperitoneal perforations can often be recognized by x-ray studies if the roentgenologist is aware of their manifestations on abdominal films.

In this particular case it was possible to make a roentgen diagnosis relatively soon after an acute abdominal episode, in spite of contrary clinical data. Such cases certainly afford a strong argument for more careful and intelligent interpretation of plain films of the abdomen.

CONCLUSIONS

1. A case of retroperitoneal perforation of the duodenum complicating an ulcer of the posterior wall of the duodenum has been presented.

2. Distribution of the extravasated air

genographic gastro intestinal study done previous to hospital admission showed "deformity of the second and third parts of the duodenum and the mid portion of the transverse colon, with complete obstruction in the mid transverse colon and retrograde filling of the bowel with barium. The changes described above have all the characteristics of a neoplasm involving the transverse colon and the adjacent structures, with some evidence of an intrinsic lesion in the colon, though this is extremely unusual in a patient of this age, and one should consider the possibility of a retroperitoneal neoplasm with infiltration of the abdominal structures as described above"

A flat plate of the abdomen was taken upon admission "A considerable amount of barium was present in the cecum and ascending colon, while only a small amount remained in the pelvic sigmoid and in the region of the ampulla of the rectum" The clinical impression was that of a subacute intestinal obstruction of unknown etiology, possibly malignant, and the patient was given supportive therapy in the form of intravenous fluids, for two days prior to laparotomy. Three 30-c c doses of a 5 per cent sodium sulfadiazine solution were given at eight-hour intervals on the day preceding operation

At operation a very large malignant lesion of the transverse colon was found, the proximal colon was dilated to about twice its normal size, while the distal section was somewhat collapsed because of the obstruction. In the mesentery, extending approximately 2 inches from the site of the original lesion, were several enlarged nodes, which were removed. A classical Mikulicz type of operation was done, with removal of 3 to 4 inches of bowel on either side of the lesion.

Gross pathologic examination of the specimen revealed a 7 cm slightly raised, pinkish gray, annular growth which markedly constricted the bowel lumen. The central portion of the tumor was ulcerated, and the entire wall of the colon about the lesion appeared to be infiltrated.

Microscopic Diagnosis "Advanced adenocarcinoma of the signet-ring type, undergoing colloid degeneration" There was no apparent involvement of the lymph nodes examined.

The *postoperative course* was uneventful, the colostomy was eventually closed satisfactorily, and the patient is doing well after nine months' time.

COMMENT

There is great variance in the literature concerning the relative incidence of carcinoma in the different sections of the colon (6, 24, 25). Comparing the figures given by Korte *et al* (24) concerning cancer of the colon in adults with the collected series of 38 cases in youth, it is found (see Table I) that, in general, the percentage of lesions



Fig 2 Gross specimen. Section of colon removed at operation, showing the carcinomatous lesion.

occurring at various sites is about the same. This is in agreement with the observations of Laird (20) and Phifer (26).

TABLE I RELATIVE INCIDENCE OF CARCINOMA IN DIFFERENT PARTS OF THE LARGE INTESTINE IN YOUNG PERSONS (UNDER SIXTEEN) AND ADULTS

	Young Persons	Adults*
	Cases	Cases
Cecum	8 (21%)	47 (16%)
Colon	16 (42%)	126 (43%)
Right side	5 (13%)	41 (14%)
Left side	7 (18%)	41 (14%)
Transverse	4 (11%)	44 (15%)
Sigmoid	14 (37%)	124 (41%)
TOTAL	38 (100%)	297 (100%)

* From the literature

Pathologically, it has been noted in the adult that the fungating, soft, friable, medullary type of carcinoma is more common in the proximal half of the colon, while the scirrhotic, napkin-ring type of neoplasm develops in the distal portion. In this series of 38 cases in youth, most of the carcinomas occurring in the transverse and distal half of the colon were of the "constricting type," thus conforming to the general rule.

The theory that most carcinomas of the large bowel originate in polyps is interesting (6). The actual incidence of malignant transformation in polyps is not known, it is given roughly as from 40 per cent (27) to 60 per cent (28). Of the young patients

Carcinoma of the Transverse Colon in a Fifteen-Year-Old Boy

Case Report with Short Summary of the Literature¹

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CARCINOMA OF the colon in youth is a rare condition. On the basis of the cases reported, the prognosis appears practically hopeless. If, however, the fact that cancer in youth can and does occur were to be stressed through the recording of all such cases, it is believed that earlier diagnosis might be established, which should in turn improve the outlook.

About 45 per cent of all the various types of cancer occur in the gastro-intestinal tract (1). Of this number, approximately 11 per cent are in the large intestine (2). Malignant tumors in youth have been variously estimated as accounting for 1 to 4 per cent of all malignant neoplastic diseases (3, 4). Thirty-two cases of carcinoma of the large intestine in patients fifteen years of age or under were reported up to 1941 (5-18). In that year Pennell (19) reviewed the literature and added another case to the list. Laird (20), also in 1941, listed 3 cases (21, 22, 23) not quoted by Pennell and added a case of his own. The case presented here is thus the 38th to be reported.

CASE REPORT

J. D. A., a white boy aged 15 years, was brought to Harper Hospital (Detroit) on March 8, 1945, by ambulance, the chief complaint being "stomach cramps" of three weeks' duration. He had previously had a number of similar attacks of abdominal cramps, the first occurring in 1943, two years before admission, at which time the pains lasted about one to two minutes and recurred every fifteen to twenty minutes over a period of twenty-four hours. There had been no nausea, vomiting, diarrhea, constipation, bloody or tarry stools, associated with the pain. Beginning in August 1944, the cramps became more frequent and more severe until the middle of February 1945, when the pain was intense and the patient vomited about once every twenty-four hours. During the three weeks prior to admission to the hospital, he had lost 15

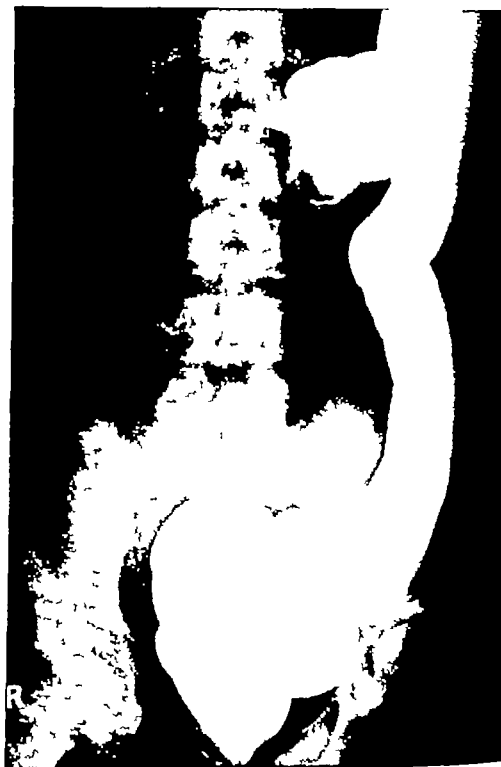


Fig 1 Barium enema study. Reproduction of a film which shows the obstruction in the mid portion of the transverse colon.

pounds in weight, his appetite was poor, and he had a moderate degree of constipation. Bright red blood was noted in the stool on a single occasion, following an enema.

The earlier history and family history were non-contributory. The only positive physical findings were in the abdomen, where there was exquisite tenderness to light palpation over the course of the transverse and descending colon. There was no rigidity, no masses were palpable, and the liver, spleen, and kidneys could not be felt.

Examination of the blood on admission revealed a slight leukocytosis, with a white blood count of 11,400 (stab cells 33 per cent, segmented cells 41 per cent, lymphocytes 16 per cent, monocytes 8 per cent, eosinophils 1 per cent). The red blood cell count was 4,680,000, and hemoglobin 93 per cent. A roent-

¹ From the Department of Roentgenology Harper Hospital Detroit Mich. Accepted for publication in December 1945.

of the colon, only 1 survived beyond a period of seven months following discovery of the lesion. Although the patient presented here is still doing well after nine months, the prognosis must be guarded.

SUMMARY

A case of carcinoma of the transverse colon in a 15-year-old boy is presented, bringing the number of cases of carcinoma of the colon to be reported in persons 15 years of age, or under, to 38.

Since the prognosis is generally bad in these cases, the hope is expressed that the mortality might be improved by more prompt diagnosis. Earlier diagnosis will be accomplished if it is kept in mind that cancer can and does occur in youth.

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coming to autopsy there is a fair percentage with polyposis, with evidence of malignant degeneration found on microscopic examination. However, of the 38 cases of carcinoma of the colon discussed here, only one showed doubtful evidence of polyposis, that of Pfeiffer and Wood (29), in which a "fibroma with adenocarcinomatous change" was found

might be considered a factor in the high mortality rate in very young people and, although cancer appears to be only slightly more common on the left side of the colon in the young as compared to older patients (Table I), it is also noted that there is a slightly higher incidence of malignant growth in the cecum in youth as compared to adults

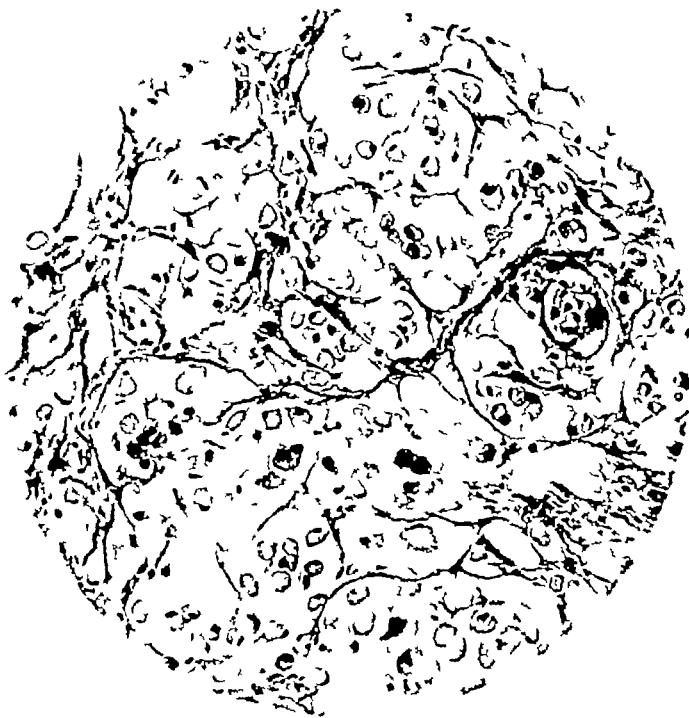


Fig 3 High power microscopic section showing adenocarcinoma under going colloid degeneration

Apparently the poor prognosis in youth is due to the inherent growth qualities in the young as compared with older persons. What had been a well-known fact to pathologists for a long time was pointed out specifically in 1934 by Pemberton (30), who analyzed 3,542 cases of carcinoma of the colon in adults and found that "the prognosis following operation is best if the malignant growth is situated in the proximal or right portion of the colon and it (the prognosis) becomes gradually less favorable as the site of the growth becomes more distant from the right side of the colon." This

In the literature it has been reported that carcinoma of the transverse colon in adult is prone to metastasize to the stomach (31). This was not found to be true in the series of similar cases in youth. It is of interest to note that early metastases occur primarily in the nodes of the fatty tissue surrounding the malignant lesion and not in the regional lymph nodes. This was first described by Dr P F Morse (31) and demonstrated in a pathological exhibit at an annual meeting of the American Medical Association in 1914.

Of the 38 young patients with carcinoma

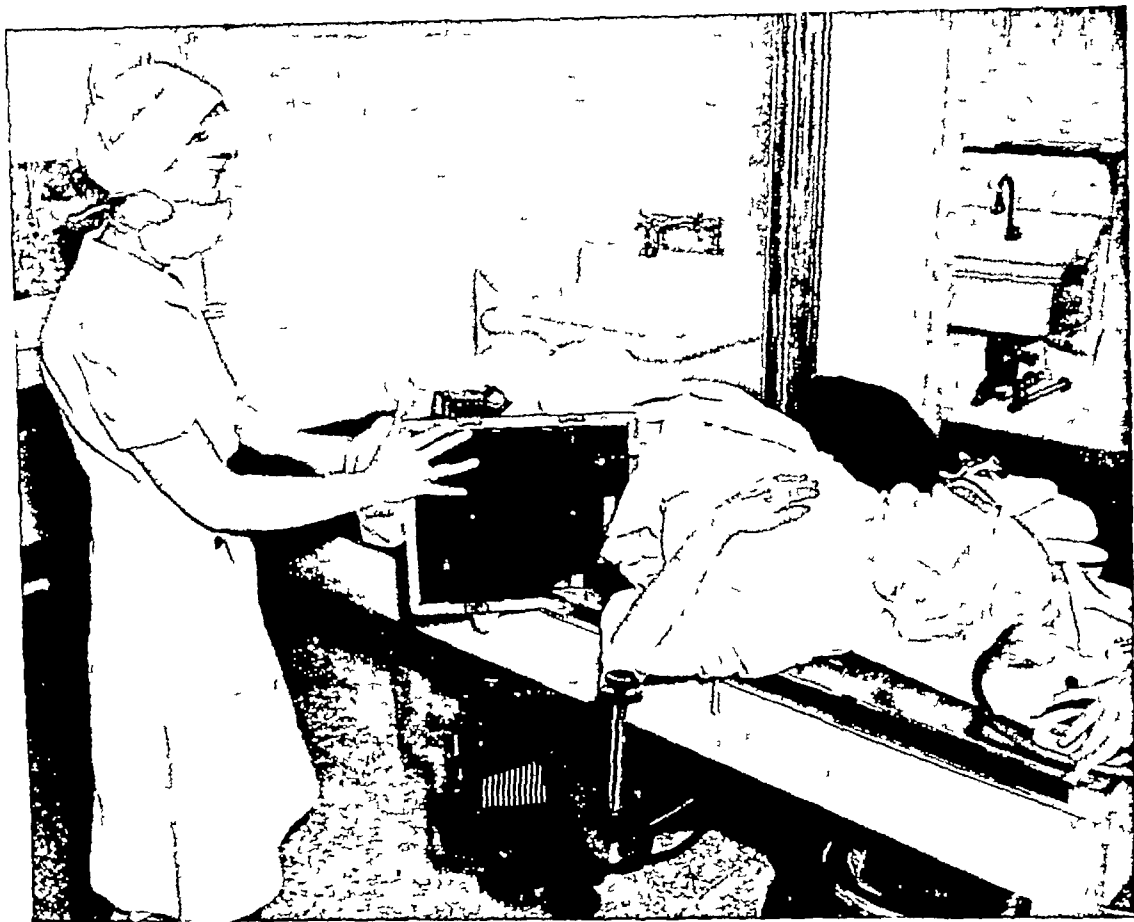


Fig 1 Patient in position on the table with the cassette inserted in the slot in the plywood top

lateral field there is no interference between him and the radiologist. The use of a wooden table top and this technic also allow for taking postero-anterior as well as anteroposterior projections if these are more convenient, requiring no shifting of x-ray equipment in order that it may be used both for fluoroscopic and radiographic study.

Our procedure is as follows. Pentothal sodium is used intravenously as an anesthetic. While the surgeon and his assistant scrub, the reduction is accomplished by the radiologist, usually by means of abduction, external rotation, then flexion and extreme internal rotation, followed by extension. This places the neck of the femur roughly parallel to the table and offers an easier angle for driving the nail. A guide pin (Steinmann pin) is placed in the neck

of the femur, either above or below the point at which the Smith-Petersen nail is to be inserted. Postero-anterior and lateral views are then taken to determine the position of the pin. With this as a guide, the Smith-Petersen nail is driven into position under fluoroscopic control, and lateral and postero-anterior views are again taken. The films are developed for one minute at 85 degrees in a small adjacent darkroom and are usually viewed before they are completely fixed.

We do not use a cannulated nail to drive over the guide pin because, on one occasion early in this series, a pin caught in the cannula of the nail and was driven into the pelvis. I have observed a similar accident at another hospital, with a fatal result.

It has been possible to follow 52 cases treated according to the method described

Some Practical Aspects of Hip Nailing¹

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FRACTURES OF the neck of the femur and intertrochanteric fractures are seen frequently in a general hospital practice. The more recent methods of internal fixation for these types of fracture have greatly simplified their management and have produced a much higher percentage of good functional results than was obtained with previous methods. In the placing of the mechanical aids, Smith-Petersen nails or Moore pins, the control of the position of the fragments of bone and of the appliance depends largely upon radiologic observations.

The purpose of this paper is to outline a method, developed by the author during the past several years, which provides adequate x-ray control and has the distinct advantage of materially shortening the procedure. With this method, placing of the nail or pin in the average intracapsular fracture is completed—from incision to closure—in twenty minutes, and intertrochanteric fractures require only a little longer. In two of our cases the entire procedure was completed in thirteen minutes.

A special table, constructed of wood, facilitates the procedure. This table has a double top of ordinary plywood with room between the two pieces to insert a film for anteroposterior views if these are desired. The wooden top also allows for fluoroscopic control during the course of the operation. In the upper sheet of plywood two slots are cut at an angle of 135 degrees. These extend into the table a total distance of 6 inches and are of such a width as to admit an x-ray plate. The patient is so placed on the table that the crest of the ilium will just touch the cassette when it is inserted in the slot (Fig 1). A small portable shock-proof x-ray unit is placed under the knee of the normal leg at right angles to the cas-

sette. This provides a lateral projection of the femoral neck. A second mobile apparatus is placed beneath the table. It is equipped with fluoroscopic shutters and, with the shutters open, is used to take postero-anterior views. Thus, neither piece of x-ray equipment has to be moved during the procedure. The film is placed in the position for the lateral projection by simply raising the sterile drapes and working beneath them. The postero-anterior projection is taken by throwing a sterile sheet over the operative field and placing the cassette on top of the sheet. When fluoroscopic control is required, the surgeon works beneath the sterile sheet while the radiologist works from above. We have had no case of infection as a result of this technic.

Mr Virgil L Barnard of Los Angeles, Calif., has described a special top to be used upon a regular operating room table which allows anteroposterior and lateral views to be taken without disturbing the sterile operative field. Our set-up is somewhat similar, but with the following differences. The entire table top is built of wood, which allows the use of a fluoroscope in checking the insertion of the guide pin and also the insertion of the Smith-Petersen nail. A second small portable shock-proof x-ray unit is used for the lateral projection. This is placed under the sterile drapes and does not interfere with the sterile field. The drapes are raised so that the film is beneath them and thus the operative field is protected.

The use of a heavy-duty mobile machine with controllable shutters beneath the x-ray table gives good visualization with the radiologist working above a sterile throw-sheet and the surgeon working below this area. Since the surgeon is working on a

¹ Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10 1945.

Application of the Inverse-Square Law to Oil-Immersed Tubes

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Highland Park, Ill

DURING THE past several years, doubt has been expressed regarding the validity of applying the inverse-square law to the small oil-immersed x-ray tubes (140 kv p and less) which are used for both diagnostic and therapeutic purposes. This doubt has been particularly emphasized in respect to the short target-skin distances which are possible with the modern shock-proof oil-immersed tube.

According to the inverse-square law, the radiation intensity at a given site varies inversely as the square of the distance from the source. It implicitly includes two factors which are often overlooked. One is that the radiation be emitted from a point source, the other that there be no absorbing or scattering media between the source and the site in question. While radiation from an x-ray tube is, of course, never actually emitted from a point source, the focal spots of these small tubes are generally so small that they can be considered practically point sources, even at short distances. The insertion of a layer of oil in the x-ray beam may, however, be an important factor in causing a deviation from the law. It was for the purpose of determining whether or not the inverse-square law could be applied under this condition that the following experimental work was done.

A wooden "jig" was constructed, into which the chamber tube of a Victoreen r-meter could be inserted at various levels. The several levels of the "jig" were so spaced that if the ionization chamber were placed in the lowest level, and then placed 20 inches from the tube target, the other levels would give distances, respectively, of 14 inches, 10.06 inches, 7 inches, and 5 inches. By the use of this "jig" it was

possible to keep all operating factors constant with the exception of target-ionization chamber distance, which could be varied with extreme accuracy. Before each set of measurements, the x-ray tube was leveled with a spirit level, and the ionization chamber centered by means of a plumb-bob and divider system. If a good synchronous type timer was connected to the x-ray machine, the timing was accomplished by it, otherwise a stop watch was used.

Eleven different tubes were tested. These included Machlett Type CYS, Machlett Thermax, Machlett Aeromax, General Electric Type SP 140, Eureka Therograph, and Picker Airflow. Kilo-voltages of approximately 80 were used. At least three determinations were made at each distance, and the arithmetic average was recorded. If one assumes a radiation intensity of 10 units at a 20-inch distance, the intensities at the other distances would be as follows, if calculated by the inverse-square law.

Distance	Intensity
5 inches	160
7 inches	81.6
10.06 inches	39.6
14 inches	20.4
20 inches	10.00

The observed intensities at the various distances were reduced to a base value of 10 units at a 20-inch distance, and these reduced values were compared with the values calculated according to the inverse-square law. The percentage of deviation of the observed from the calculated values is shown in Table I.

The arithmetic average percentage deviation at the various distances is as follows:

¹ Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

for a sufficient period of time to determine the final outcome. Six cases which we were unable to trace are eliminated. We have 48 cases definitely healed, the patients walking without support. There are 4 cases of non-union, in one of these there is fibrous union and the patient is walking with a cane, while another represents an old ununited fracture which was treated at the time of operation by freshening up the bone surfaces and nailing. In the other two cases there is failure of union in spite of good anatomical position.

Seven patients are listed as dead. In 3 of these the fractures resulted from metastatic carcinoma and the nailing was done for relief of pain. A fourth patient died of cerebral hemorrhage on the sixth postoperative day, and a fifth succumbed to uremia five weeks following the operation. The remaining 2 died after leaving the hospital and the cause of death was not determined.

Thus, in 83 per cent of all traced cases a

good result was obtained. If the 5 cases in which the cause of death is known to be unrelated to the procedure are eliminated, the figure is raised to 90 per cent.

CONCLUSION

A simple procedure has been outlined which makes it possible to pin a fractured hip in a satisfactory fashion, very rapidly, with a minimum of shock and trauma.

A simple table of wooden construction, which can be easily made by any carpenter, is the basis for this technic, allowing fluoroscopic controls during the major portion of the procedure.

No infections have resulted from this procedure.

12 Foresters Building
Mason City, Iowa

REFERENCE

- BARNARD, V. L. A New Surgical Table Top and Cassette Holder for Surgical Roentgenographic Examinations of the Hip. *Radiology* 40: 599-602, June 1943.



Application of the Inverse-Square Law to Oil-Immersed Tubes

ROBERT S LANDAUER, Ph.D
Highland Park, Ill

DURING THE past several years, doubt has been expressed regarding the validity of applying the inverse-square law to the small oil-immersed x-ray tubes (140 kv p and less) which are used for both diagnostic and therapeutic purposes. This doubt has been particularly emphasized in respect to the short target-skin distances which are possible with the modern shock-proof oil-immersed tube.

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possible to keep all operating factors constant with the exception of target-ionization chamber distance, which could be varied with extreme accuracy. Before each set of measurements, the x-ray tube was leveled with a spirit level, and the ionization chamber centered by means of a plumb-bob and divider system. If a good synchronous type timer was connected to the x-ray machine, the timing was accomplished by it, otherwise a stop watch was used.

Eleven different tubes were tested. These included Machlett Type CYS, Machlett Thermax, Machlett Aeromax, General Electric Type SP 140, Eureka Therograph, and Picker Airflow. Kilovoltages of approximately 80 were used. At least three determinations were made at each distance, and the arithmetic average was recorded. If one assumes a radiation intensity of 10 units at a 20-inch distance, the intensities at the other distances would be as follows, if calculated by the inverse-square law.

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TABLE I RESULTS OF TESTS MADE ON ELEVEN TUBES

Tube	Distance (inches)	Observed Value	Observed Value to Base 10	Calculated Value to Base 10	Per Cent Deviation from Calculated Values
1	5	288	168.5	160	
	7	144	84.5	81.6	+5.2
	10.06	69	40.3	39.6	+3.4
	14	35	20.5	20.4	+1.7
	20	17.1	10.00	10.00	+0.5
2	5	286	158	160	
	7	152	83.3	81.6	-1.3
	10.06	75.5	41.7	39.6	+2.0
	14	38	21	20.4	+5.0
	20	18.1	10.00	10.00	+3.0
3	5	208	155	160	
	7	103	78.8	81.6	-3.2
	10.06	50	37.3	39.6	-5.9
	14	26	19.4	20.4	-5.7
	20	13.4	10.00	10.00	-4.8
4	5	232	161	160	
	7	119	82.5	81.6	+0.6
	10.06	57.5	39.9	39.6	+1.0
	14	29	20.1	20.4	+0.7
	20	14.4	10.00	10.00	+1.5
5	5	408	162	160	
	7	205	81.2	81.6	+1.3
	10.06	99	39.3	39.6	-0.5
	14	50.3	20	20.4	-0.7
	20	25.2	10.00	10.00	-2.0
6	5	283	156	160	
	7	147	81	81.6	-4.0
	10.06	71	39.2	39.6	-0.75
	14	36.5	20.2	20.4	-1.0
	20	18.1	10.00	10.00	-1.0
7	5	432	160	160	
	7	222	82.2	81.6	0.0
	10.06	105	38.7	39.6	+0.6
	14	54	20	20.4	-2.2
	20	27	10.00	10.00	-2.0
8	5	392	170	160	
	7	200	86.8	81.6	+6.0
	10.06	94	40.8	39.6	+6.0
	14	46.5	20.5	20.4	+3.0
	20	23	10.00	10.00	+0.5
9	5	99	156	160	
	7	51.3	78.8	81.6	-2.6
	10.06	24.6	37.8	39.6	-3.5
	14	12.5	19.2	20.4	-4.5
	20	6.5	10.00	10.00	-5.8
10	5	140	170	160	
	7	69	83.8	81.6	+6.0
	10.06	33.4	40.6	39.6	+3.6
	14	16.8	20.4	20.4	+2.4
	20	8.23	10.00	10.00	0.0
11	5	306	153	160	
	7	156	78	81.6	-4.5
	10.06	81.9	41	39.6	-4.3
	14	41.1	20.5	20.4	+3.4
	20	20	10.00	10.00	+0.6

5 inches	+0.318%
7 inches	+0.15%
10.06 inches	+0.19%
14 inches	-1.0%
20 inches	0.0%

In analyzing these data, it is to be remembered that the figures represent the error to be expected when a measurement is made at a 20-inch distance and the inverse-square law is applied to calculate the intensity at the shorter distances. Quite obviously these errors are so small as to have no practical significance.

The averages given are for the eleven tubes and show that, on the average, the inverse-square law may be applied between 20 and 5 inches with an error not greater than 1 per cent. For individual tubes the error appears somewhat larger. A maximum positive deviation of 6 per cent was noted several times, as well as several negative deviations of about the same magnitude. Since these maximum deviations occur at various distances, and are both positive and negative, it is probable that they reflect nothing other than experimental errors.

The above deviations are small, despite the fact that the measurements were de-

liberately made in a manner to cause the inverse-square law to appear in its worst light. Measurements made at maximum distance and calculations made from maximum to minimum distance. In practical work, if one wished to make only one determination and then calculate intensities at other distances, he would hardly start at a maximum distance and calculate to a minimum. Rather, he would make the single measurement at about the middle distance and calculate to both the longer and shorter distances. If this procedure were followed, the maximum deviations or errors would be even smaller than those given above.

CONCLUSIONS

The inverse-square law may be applied in calculating variation in radiation intensities at distances from 20 inches to 5 inches with an average error not exceeding 1 per cent, and a maximum error not exceeding plus or minus 6 per cent.

My thanks are extended to the several radiologists and dermatologists who gave their kind permission for the use of their equipment for the above experiment.

1317 Judson Ave
Highland Park, Ill



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	20	25.2	10.00	10.00	-2.0
6	5	283	156	160	
	7	147	81	81.6	-4.0
	10.06	71	39.2	39.6	-0.75
	14	36.5	20.2	20.4	-1.0
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7	5	432	160	160	
	7	222	82.2	81.6	0.0
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	14	54	20	20.4	-2.2
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	14	41.1	20.5	20.4	+3.4
	20	20	10.00	10.00	+0.6



FREDERICK W O'BRIEN, M D
President, Radiological Society of North America

EDITORIAL

Frederick W O'Brien, M D

President of the Radiological Society of North America

Frederick W O'Brien, popular president of our Society for 1947, is the first representative from New England to be elected to this post. For those not acquainted with him and with his numerous contributions to radiology, a brief review of his characteristics and career will be of interest. It should be, too, an incentive to younger men entering this specialty.

Dr O'Brien's training and career indicate that a sound educational program was instituted from the start. He received his preparatory education in the public schools of Boston and his Bachelor of Arts degree from Boston College. He was graduated from Tufts Medical School in 1911, following which he practised general medicine for a period of three years. In 1914 he entered the field of radiology. For instruction in this new specialty he went to Vienna, where he studied under Kreusfuchs and Schüller, and on his return to Boston, he took further training under Ariel W George. The practice of radiology at that time was undergoing rapid changes. Deciding that further education would be of value, Dr O'Brien became a graduate student at Harvard College, where he studied in the physical laboratory under Duane (radiation physics and biophysics) during 1920, 1921, 1922, and 1923.

In 1918, Dr O'Brien became an instructor in Tufts Medical College, and has been successively assistant professor, associate professor, professor, and, since 1941, professor emeritus in radiology in his mother institution. He has been visiting roentgenologist to the Cambridge Municipal Hospital since 1918 and chief of the Tumor Clinic at the Boston City Hospital since 1939.

To name all of the positions which our new president has held would be to fill this short brief with more lists than is feasible. Some of the posts which will have special significance for our membership are as follows: president of the New England Roentgen Ray Society, 1924-25, president of the American Radium Society, 1940, Chancellor of the American College of Radiology, 1941, diplomate and trustee of the American Board of Radiology, 1940, member of the British Institute of Radiology since 1931.

Dr O'Brien is an excellent speaker and has taken part in many symposia, especially on the treatment of malignant disease. Carcinoma of the breast and cervix, two lesions which require thought and action in order that treatment of the patient will be best carried out, have been of special interest to him. I shall not list the articles which he has written or the addresses which he has given other than to say that he was the Janeway lecturer for the American Radium Society in 1946, when he spoke on the treatment of carcinoma of the cervix.

Our president's main interest outside of medicine is his family. He is married to Sara Green and they have three children: a son, now interning at the Boston City Hospital, a second son in premedical school, and a daughter, a senior at Trinity College, Washington, D C.

The election of Frederick W O'Brien to the presidency of the Radiological Society of North America gives us a man whose keenness and sharpness of mind are reflected in his own meticulous appearance.

HUGH F HARE, M D

ANNOUNCEMENTS AND BOOK REVIEWS

CANADIAN ASSOCIATION OF RADIOLOGISTS

The Tenth Mid-Winter Meeting of the Canadian Association of Radiologists was held in Quebec, Jan 3-5, with a program of great interest, including many phases of roentgen diagnosis and radiotherapy. The officers of the organization are: Dr C W Prowd of Vancouver, President, Dr Digby Wheeler of Winnipeg, Vice-President, Dr E M Crawford of Montreal, Honorary Secretary-Treasurer.

IVÈME CONGRES DES MEDICINS ELECTRO- RADIOLOGISTES DE LANGUE FRANCAIS

The Fourth Congress of French speaking electro-radiologists was held in Paris Oct 9-12, 1946, under the presidency of Dr Delherm. The program included special reports on "Chronic Vertebral Rheumatism" by Dr Lachapelle of Bordeaux, "Clinical Encephalography" by Professor Baudoin and Dr Fischgold of Paris, "Low-Voltage, Near-Distance Roentgen Therapy in Dermatology" by Dr Paul Bourdon and Dr René Bourdon of Paris, and "Contact Radiotherapy for Cancer of the Rectum" by Professor Paul Lamarque and Dr Charles Gros of Montpelier, as well as a large number of other papers.

NUCLEAR RESEARCH

Entrance of the U S Public Health Service into the nuclear research program at Clinton Laboratories, Oak Ridge, Tenn., operated by the Monsanto Chemical Company, and the organization of a new Biological Research Division as a cooperative undertaking with the National Institute of Health has recently been announced here. The program will include extensive research into the effect of nuclear radiations upon living cells and studies of the maximum safe exposure for workers in this field. Dr Alexander Hollaender, principal biophysicist of the National Institute of Health, has been assigned to the Clinton Laboratories as head biophysicist.

This cooperative undertaking will permit the National Institute of Health to take advantage of new tools now being made available at the Clinton Laboratories in its research program on such subjects as infectious diseases, nutrition, tropical disease, cancer, and fundamental studies in biochemistry and physiology. It also allows the National Institute of Health to train scientific personnel in this new field, both in fundamental biological research and health protection procedures.

The work of the Division will be divided into the following units: biochemistry, cytogenetics, general physiology, experimental radiology, and a section of cooperative studies.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE MEDICAL ANNUAL 1946 A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX Editors: Sir HENRY TIDY, K B E, M A, M D, B S (Oxon), F R C P, and A RENDLE SHORT, M D, B Sc, F R C S. Published by John Wright & Sons Ltd., Bristol, and Simpkin Marshall (1941) Ltd, London.

GASTROENTEROLOGY IN GENERAL PRACTICE By LOUIS FELNER, M D, Associate Attending Physician, Greenpoint Hospital, Brooklyn, N Y, Associate Visiting Physician, Brooklyn Cancer Institute, Adjunct Physician, Beth Moses Hospital, Brooklyn, N Y, with the Collaboration of LOUIS A. HELD, M D, Attending Roentgenologist, Beth Moses Hospital, Brooklyn, N Y, and contributions from ALEXANDER LEWITAN, M D, Consulting Roentgenologist, Norwegian Public Health Service, New York, Adjunct Roentgenologist, Beth Israel Hospital, New York, SAMUEL WALDMAN, M D, Associate Attending Physician, Greenpoint Hospital, Brooklyn, SIEGFRIED W. WESTING, M D, Roentgenologist, Brooklyn Cancer Institute. A volume of 285 pages, with 109 illustrations, including 19 color plates. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$7.50.

Book Reviews

PRINCIPLES IN ROENTGEN STUDY OF THE CHEST By WILLIAM SNOW, M D, Director of Radiology, Bronx Hospital, Roentgenologist-in-Charge, Harlem Hospital, New York City. A volume of 414 pages, with 508 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price \$10.00.

The preface to this new volume on roentgenology of the chest opens with the truism that "Roentgen interpretation in clinical medicine requires in most instances a correlation of the history, physical signs, and knowledge of physiology and pathology." Evidently, with this in mind, the author has in many chapters given considerable space to the clinical aspects of his subject, but in others the descriptions are somewhat scanty. Much attention is paid to the changing pattern of the roentgen picture during the course of various diseases.

The first three chapters of the book deal with the

The Loch Ness Monster

The Loch Ness monster appears every few years to perturb the quiet Highlanders of Northern Scotland. Similarly, some hospital administrator or medical politician brings out from time to time the old proposal to divide radiology into technical and professional portions.

It would appear that these persons have not read nor appreciated the article on this subject, prepared by the Executive Committee of the Pacific Roentgen Club, appearing in *RADIOLOGY* nearly a decade ago (29 732-734, December 1937), nor the numerous discussions in other radiological journals and in the *Bulletin* of the American College of Radiology. A study of these papers will disclose the fact that organized Radiology is determined to stand by the basic principle that the x-ray examination is, and always has been, fundamentally a medical procedure and must be directed and controlled by a physician trained in radiology. In nearly every medical specialty there are technical procedures which are a part of that specialty and cannot be divided from it.

It is therefore timely to bring before our readers, whether or not they be members of the Radiological Society of North America, the following Resolution, adopted unanimously at the Annual Meeting of the Society in December 1946.

WHEREAS One of our Counselors reports a regrettable state of affairs in his State, therefore be it

Resolved That the members of the Radiological Society of North America be reminded by means of a special editorial announcement in our Journal that it is the considered opinion of organized Radiology that the division of medical fees into so-called technical and professional portions is artificial, unsound, and inimical to the future of good medical care.



RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up to date by notifying the editor promptly of changes in officers and meeting dates Address Howard P Doub M D , The Henry Ford Hospital, Detroit 2, Mich

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary-Treasurer*, Donald S Childs M D , 607 Medical Arts Bldg , Syracuse 2, N Y

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F Hare, M D 605 Commonwealth Ave , Boston 15 Mass

AMERICAN ROENTGEN RAY SOCIETY *Secretary*, Harold Dabney Kerr, M D , Iowa City, Iowa

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F Cahal 20 N Wacker Dr , Chicago 6 Ill

SECTION ON RADIOLOGY, A M A *Secretary*, U V Portmann M D , Cleveland Clinic, Cleveland 6, Ohio

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John Day Peake M D Mobile Infirmary, Mobile
Next meeting at the time and place of the Alabama State Medical Association meeting

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary* Fred Hames M D Pine Bluff Meets every three months and annually at meeting of State Medical Society

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary* D R MacColl M D , 2007 Wilshire Blvd , Los Angeles 5

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION *Secretary* Morris Horwitz M D 2009 Wilshire Blvd Los Angeles 5 Meets second Wednesday of each month at County Society Bldg

PACIFIC ROENTGEN SOCIETY *Secretary* L Henry Garland M D 450 Sutter St , San Francisco 8. Meets annually with California Medical Association

SAN DIEGO ROENTGEN SOCIETY *Secretary* R F Nicholas M D 1831 Fourth Ave San Diego Meets first Wednesday of each month

SAN FRANCISCO RADIOLOGICAL SOCIETY *Secretary* Joseph Levitt M D 516 Sutter St San Francisco 2 Meets monthly on the third Thursday at 7 45 P M first six months of the year in Lane Hall, Stanford University Hospital and second six months in Toland Hall University of California Hospital

Colorado

DENVER RADIOLOGICAL CLUB *Secretary*, Washington C Huyler M D Mercy Hospital, 1619 Milwaukee

See, Denver 6 Meets third Friday of each month at the Colorado School of Medicine and Hospitals

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary*, Robert M Lowman M D Grace-New Haven Hospital, Grace Unit, New Haven Meetings bimonthly, second Thursday

Florida

FLORIDA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maxey Dell, Jr, M D , 333 West Main St., S, Gainesville

Georgia

GEORGIA RADIOLOGICAL SOCIETY *Secretary-Treasurer* James J Clark, M D , 478 Peachtree St , N E , Atlanta 3 Meets in November and at the annual meeting of State Medical Association

Illinois

CHICAGO ROENTGEN SOCIETY *Secretary*, T J Wachowski, M D , 310 Ellis Ave Wheaton Meets at the Palmer House, second Thursday of October, November January, February March, and April at 8 00 P M

ILLINOIS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, William DeHollander, M D , St Johns' Hospital, Springfield Meetings quarterly by announcement

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary* Frank S Hussey, M D 250 East Superior St Chicago 11

Indiana

INDIANA ROENTGEN SOCIETY *Secretary-Treasurer*, J A Campbell, M D Indiana University Hospitals, Indianapolis 7 Annual meeting in May

Iowa

IOWA X RAY CLUB *Secretary*, Arthur W Erskine, M D 326 Higley Building Cedar Rapids Meets during annual session of State Medical Society

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney E Johnson, M D , 101 W Chestnut St , Louisville

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R Anderson M D No Louisiana Sanitarium Shreveport Meets with State Medical Society

technic of roentgenography of the chest, the normal lung, and the role of the bronchial tree. Subsequent chapters take up various infections of the lungs and pleura, neoplasms, pneumoconiosis, emphysema etc. There are also chapters devoted to the mediastinum, the diaphragm, the circulatory system, and special chest problems in children.

The large number of illustrations almost puts the books in the atlas class. There are, for example, 35 pages of cuts illustrating lobar pneumonia with eight pages of text. Unfortunately the reproductions are not always of top quality.

References to other writers have been kept to a minimum in favor of simplicity of presentation, and while a bibliography is appended, no pretensions are made as to its completeness.

A MANUAL OF TOMOGRAPHY By M. WEINBRENN, B.Sc. (S.A.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.F.R. (Lond.), D.M.R.E. (Camb.), Lt. Col. S.A.M.C. Adviser in Radiology, Union Defence Force, Radiologist, Chamber of Mines Hospital, Johannesburg, Late Radiologist, Queen Mary's Hospital (Roehampton), Ministry of Pensions, Assistant Radiologist, The Middlesex Hospital (London). A volume of 270 pages, with 138 figures comprising 397 illustrations. Published by H.K. Lewis & Co. Ltd., London, 1946. Price 45s net.

This "Manual of Tomography" is the outgrowth of a lecture given by the author before the Capetown (South Africa) Postgraduate Medical Association in 1944. It is based on an experience of seven years during which he has found this technic increasingly indispensable. In the introductory chapter, he presents briefly the principles of the procedure, touching upon its history and including illustrations and brief descriptions of the apparatus employed. Subsequent chapters cover examination of the chest, spine, skull, larynx, etc. A separate chapter on technic concludes the work.

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The book is attractive in general format, and numerous illustrations demonstrate adequately the conditions discussed. A satisfactory index is appended. Roentgenologists interested in tomography will find this volume useful, and to them it is recommended.

A HANDBOOK OF RADIOGRAPHY By JOHN A. ROSS, M.A. (Camb.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.M.R.E. (L'pool), Visiting Radiologist, Alder Hey Children's Hospital, Liverpool, Hon. Radiologist, Warrington Infirmary, Warrington, Radiologist, General Hospital, Warrington, Hon. Radiologist, The St. Helens Hospital, St. Helens.

Lancs., Clinical Assistant, X-Ray Department, Royal United Hospital, Liverpool, Assistant Lecturer in Radiology, University of Liverpool. A volume of 165 pages with 92 illustrations. Published by H.K. Lewis & Co., Ltd., London, 2nd ed., 1946. Price 10/6d net.

This is a small handbook of convenient size to slip in the pocket, designed for X-ray technicians and students. It is written in an intimate, almost conversational style, giving many of the "do's and don't's" which would be less easily imparted in a more formal book.

The subject matter covers many of the standard positions in ordinary use, giving helpful suggestions for position of patients and calling attention to pitfalls which are likely to be encountered in the examination. In fact, the greatest usefulness of the book is found in these helpful suggestions.

The illustrations are outline sketches which serve more to refresh the memory of a technician already familiar with the position than to provide a detailed account of how to carry out the procedure.

The only criticism which could be offered of this excellent little book is that it attempts descriptions of so wide a variety of special examinations that none can be entirely adequate.

CHECK AND DOUBLE CHECK ON SICKNESS INSURANCE By J. WESTON WALCH, Instructor in Economics and Business Law, Portland (Maine) High School. Published by the Public Relations Bureau, Medical Society of the State of New York, 1946. A 60-page paper-bound pamphlet. Price 25 cents for separate copies, special prices in quantity.

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Following an introduction stating the problem, the text is in the form of 133 questions and answers grouped under four main headings: The Quality of Medical Care Today, 'Paying for Medical Care', "Compulsory Sickness Tax", "Voluntary Medical Care Insurance." The Ten Point Health Program of the American Medical Association and ten major arguments against the Murray-Wagner-Dingell bill taken from an address made by Dr. Haven Emerson before the 1946 National Conference on Cooperative Health Plans appear as appendices.

'For your own sake, check and double check all the facts on this vitally important subject,' says the author. For that purpose this little booklet is recommended.

RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up to-date by notifying the editor promptly of changes in officers and meeting dates Address Howard P Doub M D , The Henry Ford Hospital, Detroit 2, Mich

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary-Treasurer*, Donald S Childs, M D , 607 Medical Arts Bldg , Syracuse 2 N Y

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F Hare, M D 605 Commonwealth Ave , Boston 15, Mass

AMERICAN ROENTGEN RAY SOCIETY *Secretary*, Harold Dabney Kerr, M D , Iowa City, Iowa

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F Cabal 20 N Wacker Dr , Chicago 6, Ill

SECTION ON RADIOLOGY, A M A *Secretary*, U V Portmann, M D Cleveland Clinic, Cleveland 6, Ohio

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John Day Peake M D Mobile Infirmary, Mobile
Next meeting at the time and place of the Alabama State Medical Association meeting

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary*, Fred Hames M D Pine Bluff Meets every three months and annually at meeting of State Medical Society

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary*, D R MacColl, M D , 2007 Wilshire Blvd , Los Angeles 5

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION *Secretary* Morris Horwitz, M D , 2009 Wilshire Blvd , Los Angeles 5 Meets second Wednesday of each month at County Society Bldg

PACIFIC ROENTGEN SOCIETY *Secretary* L Henry Garland, M D , 450 Sutter St , San Francisco 8
Meets annually with California Medical Association

SAN DIEGO ROENTGEN SOCIETY *Secretary*, R F Niehaus, M D , 1831 Fourth Ave San Diego
Meets first Wednesday of each month

SAN FRANCISCO RADIOLOGICAL SOCIETY *Secretary*, Joseph Levitin M D 516 Sutter St San Francisco 2 Meets monthly on the third Thursday at 7 45 P M first six months of the year in Lane Hall, Stanford University Hospital and second six months in Toland Hall, University of California Hospital

Colorado

DENVER RADIOLOGICAL CLUB *Secretary*, Washington C Huyler M D Mercy Hospital 1619 Milwan

lee, Denver 6 Meets third Friday of each month, at the Colorado School of Medicine and Hospitals

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary*, Robert M Lowman, M D , Grace-New Haven Hospital, Grace Unit, New Haven Meetings bimonthly, second Thursday

Florida

FLORIDA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maxey Dell, Jr, M D , 333 West Main St , S , Gainesville

Georgia

GEORGIA RADIOLOGICAL SOCIETY *Secretary-Treasurer* James J Clark, M D , 478 Peachtree St , N E , Atlanta 3 Meets in November and at the annual meeting of State Medical Association

Illinois

CHICAGO ROENTGEN SOCIETY *Secretary*, T J Wachowski, M D 310 Ellis Ave, Wheaton Meets at the Palmer House, second Thursday of October, November January February, March, and April at 8 00 P M

ILLINOIS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, William DeHollander, M D , St Johns' Hospital, Springfield Meetings quarterly by announcement

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary* Frank S Hussey, M D , 250 East Superior St Chicago 11

Indiana

INDIANA ROENTGEN SOCIETY *Secretary-Treasurer*, J A Campbell M D Indiana University Hospitals, Indianapolis 7 Annual meeting in May

Iowa

IOWA X RAY CLUB *Secretary*, Arthur W Erskine M D 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney E Johnson, M D , 101 W Chestnut St , Louisville

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R Anderson M D , No Louisiana Sanitarium Shreveport Meets with State Medical Society

technic of roentgenography of the chest, the normal lung, and the role of the bronchial tree. Subsequent chapters take up various infections of the lungs and pleura, neoplasms, pneumoconiosis, emphysema etc. There are also chapters devoted to the mediastinum, the diaphragm, the circulatory system, and special chest problems in children.

The large number of illustrations almost puts the books in the atlas class. There are, for example, 35 pages of cuts illustrating lobar pneumonia with eight pages of text. Unfortunately the reproductions are not always of top quality.

References to other writers have been kept to a minimum in favor of simplicity of presentation, and while a bibliography is appended, no pretensions are made as to its completeness.

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Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7 Meets first Thursday of each month at 8 00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, Lester M. J. Freedman, M.D., 415 Highland Bldg., Pittsburgh 6 Meets second Wednesday of each month at 6 30 P.M., October to May, inclusive

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TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer* J. Marsh Frère, M.D., 707 Walnut St., Chattanooga Meets annually with State Medical Society in April

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UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE *Secretary*, Henry H. Lerner, M.D. Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital

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RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, S. R. Beatty, M.D., 185 Hazel St., Oshkosh Two-day meeting in May and one day at annual meeting of State Medical Society in September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute 426 N. Charter St., Madison 6

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary* Origène Dufresne, M.D., Institut du Radium, Montreal Meets on third Saturday of each month

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SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA Offices in Hospital Mercedes, Havana Meets monthly



ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V Schlosser M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary* Oscar O Jones M D 2622 Greenwood Road Meets monthly September to May, third Wednesday 7 30 P.M

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Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C N Borman M D, 802 Medical Arts Bldg Minneapolis 2 Regular meetings in the Spring and Fall

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, John W Walker, M D 308 E 12th St. Kansas City Mo Meets last Friday of each month

ST LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Edwin C Ernst, M D, 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month October to May

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NEBRASKA RADIOLOGICAL SOCIETY *Secretary Treasurer*, O A Neely, M D, 924 Sharp Building, Lincoln Meets third Wednesday of each month at 6 P.M in either Omaha or Lincoln

New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer* George Levene M D Massachusetts Memorial Hospitals Boston, Mass Meets monthly on third Friday at Boston Medical Library

New Hampshire

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New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary* W H Seward M D Orange Memorial Hospital

Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

New York

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CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary-Treasurer*, Carlton F Potter M D, 425 Waverly Ave, Syracuse 10 Meets in January, May, and October

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longer visible and the appearance is indistinguishable from sinusitis of any sort. The round shadow often does not appear again, as resorption occurs, and the entire cloudiness clears up at the same time. In cases of antral cyst, which on the roentgenogram may resemble hematoma, a discrete round shadow is often obscured by reaction which, on clearing, reveals the shadow again.

The time necessary for resorption of the hematoma in 11 cases was about three to ten weeks. The exact number of days in any case is only an approximation, as roentgenograms were not spaced close enough or taken soon enough after flight for exact determination. In one case, the pain was so severe that the involved antrum had to be opened and the hematoma removed.

Present Status of Localization of Intra-Ocular Foreign Bodies P Porcher, C Gianturco, E Gilles, and J Barbadault. J de radiol et d'électrol 27 1-10 1946

The authors describe the various methods of localization of foreign bodies in the eye and present the indications for each.

The method of Sweet, the first standard procedure was brought out about 1909 and has been so modified as to gain in simplicity and usefulness. The authors give a comprehensive and unusually illuminating description of the procedure and apparatus, dealing fully with the construction of the graph. They list the causes of error under two heads, errors of manipulation and technic and errors inherent in the method itself. Stevenson has worked out on geometrical lines eight possible positions of the foreign body in a theoretical sphere where accuracy cannot be expected with the Sweet method.

The physiological method of Porcher is based upon movements of the orbit. It does not necessitate apposition of the cornea to any instrument and thus avoids further trauma to the eyeball. The technic and sources of error are fully discussed.

Gianturco's method [see Radiology 40 371, 1943] is based upon stereoscopy in the anteroposterior and lateral projections, and the caution is given that the cassette must be placed very exactly for the two exposures. In the modification made by Pfeiffer, special apparatus is employed, with a correction chart.

Publication of a new stereoscopic method devised by Chausse is promised for the future.

PERCY J DELANO, M D

Sialography T E Beyer. Rocky Mountain M J 43 210-216, March 1946

For sialography from 10 to 175 cc of warm lipiodol is injected into Steno's duct following surface anesthesia of the papilla with pontocaine. Lateral and posterior films made immediately thereafter will show characteristic shadows in the presence of radiopaque calculi. Chronic parotitis (acute parotitis is a contraindication), fistulae, and xerostoma and will distinguish between extrinsic neoplasms and those of the gland substance. The procedure also makes possible the differentiation of benign mixed tumors and those which have undergone malignant change with invasion of neighboring tissues, but radical surgery for a malignant lesion should not be based solely on the roentgen findings.

Wharton's duct may also be injected with lipiodol

(about half as much as in the parotid duct), but the procedure is of limited value for the demonstration of submaxillary gland tumors.

The article contains many interesting illustrations.
PERCY J DELANO, M D

Dysphagia Due to Causes Other than Malignant Disease A S Johnstone. Edinburgh M J 53 160-172, April 1946

Pathological conditions producing dysphagia are discussed and classified according to the age groups in which they are most commonly found in the radiological department of a general hospital. Congenital atresia and congenital stricture, web, shortening, and spasm of the esophagus are the most frequent causes of dysphagia in the first decade of life, congenital stenosis and simple stricture in the second, achalasia in the third, post-cricoid web in the fourth and fifth, peptic ulceration of the esophagus and partial thoracic stomach in the fifth to seventh. Pharyngeal diverticulum is usually seen after the age of sixty. Other conditions found in the older group are tertiary contractions, benign tumors, nervous lesions, and extrinsic pressure from cardiovascular conditions. The fluoroscopic and roentgen findings are described.

THE CHEST

Pulmonary Function Tests G G Ornstein, Myron Herman, M W Friedman, and Ernest Friedlander. Am Rev Tuberc 53 306-332, April 1946

Pulmonary function can be judged on the basis of three factors: (1) ventilatory capacity, (2) permeability, or the diffusion of oxygen and carbon dioxide in the alveolar component of the lung, and (3) extraneous factors such as toxemia, anemia, etc.

The simplest ventilatory test is the measurement of the vital capacity and its comparison with the calculated normal vital capacity. One means of measuring ventilatory capacity is to determine the maximum breathing capacity by having the subject, connected to a spirometer, breathe as deeply and as rapidly as possible for thirty seconds, the results being recorded on a moving drum. It has been determined that the average maximum breathing capacity for males is 15½ liters per minute for females 100 liters per minute. The average resting minute ventilation has been found to be 7.5 liters for either sex. By dividing the maximum by the resting minute ventilation the authors determine what they designate the "ventilatory reserve namely," 20 for males and 13 for females. They believe this calculation offers the most information that can be obtained on ventilatory capacity, since variation in either the resting or the maximum breathing capacity will affect the end result. It has been shown that when the ventilatory function of the lungs is reduced below 60 per cent of the calculated normal vital capacity, dyspnea will appear on exertion.

The authors describe a method for measuring the efficiency of alveolar permeability using a rebreathing apparatus and include tables showing the normals for males and females.

A series of patients with impaired lungs was studied, and a number of the case reports, with reproductions of roentgenograms, are published. It became apparent that the roentgenogram was of limited value in estimating the capability of the lungs to diffuse oxygen and carbon dioxide. In some instances the roentgenogram

THE HEAD AND NECK

Colloid (Paraphysal) Cysts of the Third Ventricle
Archer A Wilson West Virginia M J 42 49-53,
March 1946

Colloid, paraphysal or neuro epithelial cysts arise from the velum transversum of the anterior part of the roof of the third ventricle, from an embryonic anlage of the paraphysis, which is a rudimentary structure in man but is fully developed in the lower vertebrates as the paraphysal gland. Owing to the narrow confines of the ventricle and to their anterior location these cysts may block the foramina of Monro and thus give rise to dilatation of both lateral ventricles with production of symptoms indicating an acute increase in intracranial pressure, namely headache, nausea and vomiting, dizziness, visual disturbance, and perhaps unconsciousness, convulsions, apathy, stupor, mental symptoms, vegetative disturbances, and even sudden death. Since the tumors are more or less suspended above the foramina of Monro, the obstruction may be intermittent, depending upon postural changes.

A case is reported in a 24-year-old man who for three years had been subject to bouts of generalized headaches, often of sudden onset. In the last few months he had experienced attacks of dizziness when stooping over, but there was no definite history of nausea, vomiting, or other symptoms suggesting an intracranial lesion. The physical examination was essentially negative, except for a slight increase in the size of both blind spots.

Ventriculograms showed greatly dilated lateral ventricles with a small amount of air in the third ventricle and no shift findings indicative of a mid-line tumor obstructing the foramina of Monro and therefore in the anterior part of the third ventricle. A right frontal craniotomy was performed and the third ventricle was approached through a cone like incision in the frontal lobe. As the right foramen of Monro was exposed a smooth, grayish, glistening mass was seen presenting through the foramen. The foramen was enlarged and the tumor was removed with ease and without hemorrhage. The patient was entirely relieved of his symptoms. Three years later he was passed by his local draft board for induction.

The pathological specimen consisted of almost entirely coagulated, partly laminated, colloid like material including only a few cells. In one area some bipolar and multipolar cells resembling astrocytes were found. No cyst wall was demonstrable.

J E WHITELEATHER M D

Leptomeningeal Cyst Associated with Hemiplegia and Skull Defect of Traumatic Origin Moses Cooperstock J Pediat 28 488-492 April 1946

Leptomeningeal cysts, with associated skull defect and hemiplegia are produced by severe head trauma invariably accompanied by skull fracture, usually of the comminuted or depressed variety. The cysts develop as the result of laceration of the arachnoid pia mater and in many cases the dura mater as well. The skull defect is the result of resorption of the bone overlying the cyst and is brought about by the pulsating pressure of the brain much as bone resorption is pro-

duced by aortic aneurysms in proximity to such bony structures as the sternum, ribs and vertebrae. The neurologic changes are due to destruction of the regional cortical tissue of the brain.

In the author's case this syndrome followed a severe skull fracture sustained at the age of five months. The patient was observed over a period of ten years, until operation was undertaken.

Roentgen studies of the skull on the day of the accident showed a fracture extending from the sagittal suture into the mid portion of the right parietal bone, as well as less prominent linear fractures in this area. There was also a suggestion of a fracture through the occipital squama. The presence of a depressed fracture in this film was not definitely apparent. Roentgenograms taken after four and one half months showed a later area of bone resorption, made up of circumscribed areas of rarefaction with slight sclerotic change at their margins. Films taken periodically over the next ten years showed persistence of the defect. There was suggestion of a disturbance of ossification as evidenced by the irregularly increasing thickness of the skull in the involved area.

The first evidence of hemiplegia was weakness of the left arm apparent at the age of seven months followed by weakness of the left leg. Moderate atrophy of both extremities developed in the ensuing years.

At operation the left meningeal cyst was opened and 10 c c of fluid were removed. The cortex of the underlying brain appeared to be destroyed for a depth of 2.0 cm. The bony defect was closed with a tantalum plate. The results of this procedure are not recorded.

An awareness of the possible presence of a leptomeningeal cyst together with repeated roentgen examination of the skull for the detection of bone resorption in such cases in young infants will doubtless lead to earlier diagnosis and to prompt surgical treatment.

Aerohematoma of the Sinuses R Wesley Wright and Harold M E Boyd Arch Otolaryng 43 357-370 April 1946

Hematoma of the paranasal sinuses is a relatively new and interesting diagnostic entity emerging from the accelerated flying program of the war. It is a rather uncommon finding associated with obstructive aer sinusitis and, because of its relationship to the latter condition, it is suggested that the term 'aerohematoma' be applied to it. Twelve cases were studied by the authors during a two year period. In 11 of these cases the hematoma occurred during a simulated flight in the low pressure chamber. These were the only cases encountered in over one hundred thousand such flights.

The outstanding symptom in the authors' cases was pain coming on during actual or simulated flight. Other symptoms were soreness over the sinus areas, numbness of the face and teeth, discharge of fresh or old blood from the nose and in a single case dizziness. In 8 of the 12 cases there was a history of a slight cold or sinusitis at the time of the flight.

Roentgenograms in cases of hematoma usually show a well defined round shadow. Later the entire sinus may become cloudy, probably from the accompanying reaction to the blood. The discrete shadow is then no

the subject As a result of this meeting and of subsequent research, it was decided to standardize 70 mm photofluorographic equipment as follows

- (1) The photofluorographic film should be of the blue sensitive type
- (2) Photofluorographic screen should be of the blue-emitting type
- (3) Photofluorographic screen should be 15 × 17 inches in size
- (4) The distance from the x-ray tube to the photofluorographic screen should be 40 inches
- (5) The x-ray tube shift for stereoscopy should be 2.5 inches
- (6) The distance between the centers of successive exposures on the 70 mm film roll should be 3.25 inches

L W PAUL M D

Photofluorographic Roll-Film Viewers Ira Lewis
Pub Health Rep 61 294-297, March 1 1946

For the most part direct viewing systems have been used in America for the interpretation of photographic films whereas in Great Britain the projection system has been preferred A study was made of the relative merits of the two methods by the Radiology Section of the Tuberculosis Control Division (U S Public Health Service) The optimum conditions under which photofluorographic films are viewed require that the following criteria be observed (1) all detail which is present in the film must be reproduced at the retina of the observer's eye (2) eye strain must be reduced to a minimum, and (3) mechanical operation of the viewing device must be as simple as possible Although in the past the projection system of viewing has been in many respects preferable to the direct system the direct viewers now becoming available overcome the previous difficulties and are felt to offer the closest approach to the ultimate in viewing system design

Separation Center Chest Survey Louis Schneider
Dis of Chest 12 147-152, March April 1946

During the first six months of operation of the Fort Dix Separation Center, 9 658 enlisted men, 1 084 officers and 291 women were discharged for other than physical reasons A photoroentgen chest survey (4 × 5-inch film) prior to discharge showed no evidence of pulmonary disease in any of the women The findings in the 10 742 men were as follows

Pulmonary tuberculosis 4 minimal active cases (induction films had been negative less than two years earlier), subsequently proved by hospital study 3 additional cases unproved, 1 bilateral actively advancing case, 26 cases of healed or arrested foci The incidence of new cases of pulmonary tuberculosis in previously screened men who had seen active service for about two years was thus less than one in two thousand

Atypical pneumonia 11 cases

Pneumoconiosis 3 cases all in former coal miners

Bullous emphysema 6 cases, of which 5 were asymptomatic while the sixth gave a history of a non-disabling chronic bronchitis

Bronchiectasis and basal fibrosis 3 cases of bronchiectasis and 6 of asymptomatic fibrosis

Pulmonary coccidioidomycosis 1 arrested case contracted in the San Joaquin Valley

Hilar adenopathy other than calcified lymph nodes 1 case unchanged since induction a year and a half earlier and 1 case suggestive of Boeck's sarcoid

Miscellaneous findings included a large non toxic sub-sternal thyroid a calcified pleural plaque, and 2 cases of organized interlobar exudate

HENRY K TAYLOR, M D

Community Organization for Mass Chest X-Ray Surveys A Plan in Operation in Delaware County, Pennsylvania. J W Cutler, A M Sharpe, J W Wood and R W Bernhardt Am Rev Tuberc 53 224-239, March 1946

Experience has shown that the only satisfactory method of finding undiagnosed cases of pulmonary tuberculosis consists in making roentgenograms of the chest of every person in the community and repeating the process at intervals The present paper describes the development of a co-operative case-finding program in Delaware County, Pennsylvania As is essential the private physician is the backbone of the movement The name of the family doctor designated by the patient at the time of the survey, becomes a part of the survey record and x-ray reports are sent only to him

A Chest Survey Committee is made up of 12 members as follows Two representatives each from the county medical society the voluntary tuberculosis association, and the Department of Health, and one each from the general public, labor, industry schools health and welfare agencies and hospitals and sanatoria The main functions of this committee are to establish harmony of purpose, develop community co-operation avoid duplication of effort, and direct the case finding program along progressive and scientific lines The interpretations are made only by qualified roentgenologists, phthisiologists, or experienced public health physicians This is essential in order to maintain a high standard of quality of x-ray reports The following types of reports are sent to the family physician (1) negative or normal (2) healed primary tuberculosis, (3) questionable disease further supervision and study indicated, (4) minimal disease probably tuberculosis, (5) advanced disease, probably tuberculosis, (6) significant findings other than tuberculosis supervision and study indicated Each report indicates the necessary steps that should be taken for further study of the patient

L W PAUL, M D

The St Louis County Tuberculosis Survey Roberts Davies G A Hedberg and Mario Fischer Am Rev Tuberc 53 240-249 March 1946

The methods used in conducting a tuberculosis survey of the whole population of St Louis County, Minnesota, are described The policy making committee for the survey was made up of members from the state and local departments of health the county medical society, tuberculosis associations etc Every effort was made to have the community assume the responsibility and the credit for success of the survey A mobile photofluorographic unit was used and a report on every film was sent to the individual's own physician

In one year of operation 34 054 persons were examined, of whom 579 showed lesions considered to be significant tuberculosis Studies for activity were done at the Sanatorium only if there were suggestive symptoms x-ray evidence of exudative lesions or cavitation or tubercle bacilli in the sputum or gastric contents Forty-two of the 579 persons with pre-

showed an extensive bilateral infiltration of the lungs and in such cases the ventilatory function was also markedly impaired. Yet the diffusion test indicated that the lungs were capable of diffusing oxygen and carbon dioxide as well as the lungs of a normal subject. It is apparent therefore that complete information concerning pulmonary function cannot be obtained unless the efficiency of alveolar permeability is determined in addition to the ventilatory reserve.

L W PAUL M D

Primary Lung Cancer in Childhood. Report of an Unusual Case. Archibald Dick and Hugh Miller. *Brit M J* 1 387-388, March 16 1946

In a case of primary lung cancer in a 9 year old girl the correct diagnosis was not established until autopsy. A single metastasis in the left femur produced symptoms eight months before the pulmonary lesion was recognized. Histologic examination of necrotic material from the bone first suggested the possibility of a neoplastic process. The local response to deep x ray therapy (2000 r) was satisfactory and substantiated this diagnosis. A roentgenogram of the chest at this time showed enlarged partially calcified hilar and peribronchial nodes with peribronchial thickening in the upper lung fields. When the patient returned to the hospital four months later with pulmonary symptoms the first impression was that she had secondary deposits in her right lung causing a massive effusion. The roentgenographic findings were now consistent with those of a massive pleural effusion and it was not until a second aspiration was attempted that a large malignant tumor of the right lung was recognized. This was thought to be secondary to the lesion of the femur. X ray therapy to the chest was carried out as long as the patient's condition permitted (ten days). She died about two weeks later. At autopsy the primary tumor was found to be a bronchial carcinoma while the lesion of the left femur was secondary.

Multiple Pulmonary Hemangiomata. Paul Todd Makler and David Zion. *Am J M Sc* 211 261-266 March 1946

A pulmonary hemangioma called also pulmonary arteriovenous fistula is a knot of blood vessels connected by feeder vessels to both the pulmonary arterial and venous circulations so that the blood can pass from the arterial to the venous side without being oxygenated. All changes other than the low oxygen saturation are secondary to the anoxemia.

A case is reported of a young man who had experienced severe cyanosis and mild dyspnea on exertion since the age of fourteen. The fingers were markedly clubbed. A slight polycythemia was present. A chest film made at the age of seventeen was called normal. The patient was discharged at that time with a diagnosis of congenital heart disease probably interauricular septal defect but the diagnosis was considered unsatisfactory because of the absence of a murmur. At the latest admission three years later a small telangiectasis was present behind the right ear. A murmur was heard in the left fourth interspace. A review of the old films showed a nodule in the right lung measuring 2.0 cm and one in the left lung measuring 3.0 cm. Fluoroscopically these and others which developed later varied in size with changes in intrathoracic pressure during the Valsalva experiment.

The nodules were connected with each hilum by linear shadows which were interpreted as feeder vessels.

The authors rule out lesions other than pulmonary hemangiomata by exclusion. They compare their case with 7 cases of pulmonary hemangioma found by them in the literature. All of the other cases have also been in young adults. Dyspnea, cyanosis, finger clubbing and polycythemia have been common to all. None of the patients had demonstrable cardiac or lung disease. Four had known hemangiomata elsewhere and three had multiple pulmonary lesions. Hemorrhage occurred in two cases.

The most important lesion to rule out in the differential diagnosis is congenital heart disease.

BENJAMIN COPLEMAN M D

A Roentgen Ray and Clinical Study of Primary Tuberculosis. Vollmer Patch Test Made on Four Hundred and Sixty Patients, Positive Reactions Secured in One Hundred and Fifteen. Alfred D. Biggs with technical assistance of Irene Stolp. *Arch Int Med* 77 393-404, April 1946

In a series of 460 children studied for tuberculosis by the Vollmer patch and purified protein derivative tests at St. Luke's Hospital, Chicago, 115 reacted to at least one of the tuberculin tests. The Vollmer patch test agreed with the purified protein derivative test in 100 out of the 115 cases. Of the 15 children in whom the tests did not agree, 14 had positive reactions to one of the purified protein derivative tests and a negative reaction to the Vollmer patch while in one child the converse was true. These facts indicate that neither test is infallible and that the Vollmer patch test is slightly less sensitive.

Each of the 115 children reacting positively to tuberculin was examined at least once roentgenologically. In more than half serial roentgenograms were made over a period of five years and in some over a period of ten years. The lesion of primary pulmonary tuberculosis appears first peripherally. The usual location is the first, second or third intercostal space on either the right or left side or more commonly on both sides. It may also be in the apex. This initial lesion is rather ephemeral and rapidly hardens. At the same time, the shadows of the hilar lymph nodes enlarge. The end results are calcified hilar nodes and linear peripheral markings. In the present series a Ghon tubercle was decidedly the exception. Calcification of the hilum occurred in 84 cases.

The majority of the patients in the present study had calcified nodes at the first examination. In 18 calcification began while the patients were under observation. The interval between the first roentgenogram showing tissue change and one showing calcium shadows varied from a few months to three years; in the majority it was between six months and two years.

Standardization of Photofluorographic Equipment. Russell H. Morgan and Willard W. Van Allen. *Am Rev Tuberc* 53 291-296 April 1946

Due to recent expansion in the number of companies producing photofluorographic equipment it seemed desirable to bring about some degree of standardization in basic design. The Tuberculosis Control Division of the U. S. Public Health Service requested the National Electric Manufacturers Association to call a meeting of representatives of the x-ray industry for discussions on

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accompanying mitral stenosis is rather unusual in rheumatic heart disease. The authors account for it in their case on the basis of an interstitial valvulitis due to the rheumatic process. This involvement did not produce stenosis, verrucae, shortening and fusion of chordae tendinae, fusion of the cusps, or calcification. It did, however, produce rubbery, curled, and puckered mitral leaflets which, together with a marked dilatation of the mitral ring, resulted in improper closure of the valve and mitral insufficiency. The imperfect closure of the mitral valve allows a certain amount of blood to regurgitate from the ventricle into the left auricle, so that at the end of auricular diastole this chamber contains not only blood which it has received from the lungs but also that regurgitated from the left ventricle. This necessitates dilatation and, as increased work is required to expel the augmented contents hypertrophy of the left auricle. In the case under discussion the rheumatic lesions were of greater severity in the left auricle than anywhere else in the heart, and once dilatation began, the condition of this chamber became progressively worse, until it was finally an enormous sac with very little contractility. "It is astonishing," the authors say, "how long such a patient may live before congestive failure sets in but the whole sequence of events is slow and compensation is maintained by hypertrophy of both ventricles."

The fluoroscopic and roentgenographic findings in these cases are described as characteristic. The auricles, located in the right portion of the cardiac silhouette, form a double contour shadow. In the right anterior oblique position the enlarged left auricle encroaches upon the mid portion of the retrocardiac space. With the aid of a barium paste displacement of the esophagus backward and to the right may be demonstrated.

HENRY K. TAYLOR, M D

Cardiac Enlargement in Fever Therapy Induced by Intravenous Injection of Typhoid Vaccine. H. Stephen Weens and Albert Heyman. Arch Int Med 77 307-316 March 1946.

To determine whether cardiac enlargement occurs following the induction of fever therapy by intravenous injection of typhoid vaccine for neurosyphilis teleroentgenograms of the heart were taken on 15 patients preceding fever, following each paroxysm, and several weeks after the completion of therapy. In each repeat examination special effort was made to obtain a roentgenogram with the diaphragm in a position comparable to that of the original film, when this was not possible, the patient was excluded from the study. Deep inspiration was avoided in order to eliminate an involuntary Valsalva effect. The size of the heart was determined in each roentgenogram by measuring the transverse diameter. Since normally the amplitude of the right border of the heart varies from 2 to 3 mm and that of the left border from 3 to 5 mm changes under 8 mm were not considered significant.

Cardiac enlargement was found in 8 of the 15 cases with increases in transverse diameter varying from 1.0 to 2.3 cm. In 2 patients there was an associated pulmonary congestion, and in 2 others small areas of atelectasis developed. In a second group of 24 patients, teleroentgenograms were obtained from three to twelve months after fever therapy and compared with those made before treatment. The heart was found to be larger in 4 patients, all of whom had had fever therapy within the preceding six months.

Electrocardiographic studies and determinations of cardiac output, blood proteins, and hemoglobin revealed no significant differences between the patients with and without cardiac enlargement. There appeared to be no relationship between increase in cardiac size and changes in blood volume. None of the factors known to influence cardiac size, such as anemia, nutritional deficiency, or overwork of the heart, was thought to be the sole cause of the enlargement.

The occurrence of cardiac enlargement following fever therapy is of interest not only in the treatment of neurosyphilis but also in the consideration of the effects of febrile illnesses on cardiac function. The use of fever therapy provides an opportunity to study these effects under controlled conditions, and suggestions as to further investigation of this problem are offered.

Dextrocardia in Association with a Short P-R Interval with Prolongation of the QRS Complex. Report of a Case. William D. Stubenbord. U S Nav M Bull 46 412-416, March 1946.

A case of dextrocardia in conjunction with the syndrome of the short P-R interval and prolonged QRS complex in a 31-year old sailor is presented. The combination of these two entities in the same person is a rare occurrence. There was also a transposition of the abdominal viscera. Despite these congenital anomalies, the patient was able to perform all his duties.

Clinical and Roentgenologic Diagnosis of Pericardial Effusion. Nathan M. Fenichel and Bernard S. Epstein. Ann Int Med 24 401-412, March 1946.

The principal causes of massive pericardial effusion are rheumatic fever and tuberculosis. Lupus erythematosus disseminatus, pyogenic infections, malignant tumor, myxedema and the terminal phase of cardiovascular failure are less frequent etiologic agents.

The most common complaint is precordial discomfort or a sense of weight subternally. Dyspnea may be distressing, and cyanosis of the face and distention of the neck veins are common. There may be some dysphagia, an irritative cough, and a somewhat anxious facies.

None of the clinical nor roentgenologic criteria is considered absolutely diagnostic. It is most difficult to make a clear differential diagnosis between cardiac dilatation and pericardial effusion and the presence of basilar pulmonary opacities further complicates matters. The most reliable sign of pericardial effusion is the broad area of absolute cardiac dullness extending from the right midclavicular line to the left midaxillary line. Increased venous pressure is a constant finding, and a paradoxical pulse is frequently present.

The induction of hydropneumopericardium is a well established therapeutic procedure in tuberculous pericarditis. The authors have found it to be also a reliable aid in the diagnosis of pericardial effusions. Hydropneumopericardium presents a roentgenologic appearance which cannot be mistaken and has the advantage of being equally positive in the presence of concomitant pleural effusions or other basal pulmonary disease. The fluid level is demonstrable within the pericardial sac in the frontal and lateral projections, while fluoroscopic examination reveals the waves produced by the heart action.

The authors' series consisted of 13 patients with massive pericardial effusion. Six had rheumatic peri-

sumably tuberculous lesions were admitted for study, 30 were found to have active disease and 12 were discharged as inactive after a short period of observation. The cost of the survey for one year amounted to 56 cents per person examined, \$33.07 per case of significant tuberculosis found, and \$308.79 per definitely or suspiciously active case. L. W. PAUL M.D.

Tuberculous Pleural Effusion Daniel J. Feldman and Howard P. Lewis M. Clin. North America 30: 245-261, March 1946

It is generally conceded that 80 per cent of pleural effusions in young persons are of tuberculous etiology, and for this reason even a small and transient effusion cannot be dismissed lightly when the cause is not obvious.

Fifty-nine patients (56 males, 3 females) with pleural effusion were studied at an Army Hospital by the authors. The ages varied from twenty to forty-seven, but only five of the group were over thirty. Many, when seen, were in the resolving stage of the disease with only residual pleural exudate or pleural thickening of variable degree. In 39 patients the effusion was right-sided, in 18 left-sided, and in 2 bilateral. In 34 patients the onset of the illness was insidious with mild prodromal complaints, in 16 an acute onset followed a period of prodromal symptoms. 9 cases had an acute fulminating onset with no significant prodromal symptoms. Total and differential blood counts failed to reveal any constant variation regardless of the phase of the illness. The sedimentation rate was significantly elevated in 55 patients. Skin tests with purified protein derivative injected intracutaneously showed positive reactions to either the 0.00002 mg. or 0.005 mg. dose in 56 of 57 patients. Throat cultures were made in 36 cases but no significant correlation of the findings with the clinical condition was observed. No significant increase in titer of cold agglutinins was noted either at the onset or during the course of the illness in the 23 patients examined. Cultures and smears of the pleural fluid for pyogenic organisms were negative in all instances, smears of the centrifuged sediment failed to reveal tubercle bacilli. One positive sputum was found in the entire group and this was positive by culture. Four patients were found to have tubercle bacilli in the gastric contents.

Chest roentgenograms of each patient were taken serially throughout the period of observation. The changes preceding and following the acute phase of the pleural effusion were of special interest. A notable thickening of the pleural membranes was observed in nearly all cases in which the fluid had not been evacuated and was allowed to absorb. When air had been introduced and the effusion was not subsequently removed, chronic localized areas of hydropneumothorax persisted often for months. The initial pleural thickening often as much as 4 cm., had an appearance similar to that of a fibrous coagulum. Extraordinarily slow absorption of these plaques took place and in many of the patients the sedimentation rate remained elevated during most of the time required for organization. Those patients whose fluid when aspirated showed a coagulum or a firm clot exhibited a high incidence of what was apparently a sudden and spontaneous clotting of the whole fluid mass in the pleural space. Organization and absorption of these coagula were exceedingly slow and almost always resulted in a fibrothorax. In 52 of the cases studied there was evidence

evidence of pleural thickening to a significant degree. Complete, uncomplicated resolution occurred in only 5 of the patients during the period of observation. The great majority of the films showed no evidence of parenchymal disease. Seven patients had exudative parenchymal lesions. Only 2 patients had discernible calcified areas.

A diagnosis of atypical pneumonia had been made in most of the patients in whom a significant parenchymal infiltration preceded the effusion. In many others the hazy density at the base, combined with the mild atelectatic changes in the adjacent lung and the common hilar swelling on the affected side were thought to be due to pneumonia and the effusion was believed to be a postpneumonic exudate. Enlargement of the hilar lymph nodes was seen frequently.

While only a small number of the patients in this series were proved to have tuberculosis by recovery of the organism, nevertheless because of the marked similarity of the cases and the elimination of other possibilities, the authors are convinced that all of the cases were tuberculous.

As to the treatment the authors believe that after the afebrile period has passed and reasonable stability in the effusion has occurred, ordinarily in two to three weeks the fluid should be evacuated completely in successive stages if necessary depending upon the size of the effusion. By this procedure the coagulation of large effusions can be prevented and the marked fibrous deposits on the pleural surface avoided. Since the complete removal of fluid results in approximation of the pleural surfaces and thereby fosters their adherence it would seem desirable that a pneumothorax of at least 200 to 300 c.c. be induced initially. Adequate x-ray observation of the underlying lung may then be made and if necessary collapse therapy may be continued.

Massive Left Auricle, with Special Reference to Its Etiology and Mechanism Report of a Case Aaron E. Parsonnet, Arthur Bernstein and Harrison S. Martland. Ann. Heart J. 31: 438-450, April 1946.

A 33-year-old white man died suddenly of rheumatic heart disease. He had had rheumatic fever at the age of eight and was subsequently told that his heart was affected though he had no cardiac symptoms until the age of 29 in spite of undue physical exertion—frequent boxing bouts, long distance running, etc. The first symptom referable to the heart was a short hacking cough. At 31 years of age the patient began to experience dyspnea on slight exertion, and edema of the ankles appeared. He was hospitalized at various intervals after the appearance of symptoms and a diagnosis of rheumatic heart disease with massive left auricle was made. The authors do not mention roentgen examination in their record of the case but films are reproduced showing extreme enlargement of the heart, with a transverse diameter of 30 cm. and a vertical diameter of 25.5 cm.

Following the patient's sudden death three years after the onset of symptoms the heart was found to fill practically the entire chest. It contained over 2000 c.c. of dark fluid blood, most of which was in the tremendously dilated left auricle which measured 14 cm. in diameter. Empty the heart weighed 1600 gm. There was no evidence of predominant mitral stenosis but the chief anatomic valvular lesion was a mitral insufficiency. Mitral insufficiency without an

ments in the gastroscope so that blind areas may be eliminated and biopsies easily taken

CLARENCE E WEAVER M D

An Individual Method of Graduated Compression Applied to Radiologic Research in Organic Lesions of the Stomach and Duodenum (Early Cancer Excepted)
R Hickel J de radiol et d'électrol 27 10-19 1946

The author presents his experience of six years with a compression technic which he devised for study of the stomach and duodenum. He deals first with the arguments of those who contend that compression produces a false image, a distortion which leads one to describe as pathologic certain duodenal bulbs which would not be considered so but for the compression. He comments also upon a debate which has continued about the relative merits of the upright and prone positions. He attaches little significance to the mucosal relief pattern without compression as an adjunct measure.

The method employed is essentially that of the Holzkecht spoon, plus a spot film device. The illustrations included are all of rather advanced lesions and it would seem that anything the author shows here can be seen nearly as well in non-compression films.

PERCY J DELANO M D

An Evaluation of Criteria Useful in the Differentiation of Benign and Malignant Lesions of the Stomach
Henry J Tumen Pennsylvania M J 49 609-614, March 1946

Carcinoma of the stomach and benign peptic ulcer may so closely mimic each other that all available laboratory and roentgenologic aids may not be sufficient for a differential diagnosis.

The average age of onset of carcinoma of the stomach is about fifty five, symptoms of duodenal ulcer usually appear between the ages of twenty and thirty and benign gastric ulcer has its onset at about forty. Gastric ulcer on the basis of sclerotic change may however, be encountered at sixty or seventy, and gastric cancer may be seen between twenty and thirty. The age of the patient is therefore, at best merely suggestive of the diagnosis.

The occurrence of earlier attacks of pain of the same nature is strongly suggestive of a benign lesion but it may be impossible for the patient to differentiate between the pain due to a beginning cancer and that from a previous benign ulcer. A long continuous history of digestive discomfort suggests cancer rather than benign ulcer, as the latter is characterized by a tendency to spontaneous remissions.

Massive hemorrhage usually occurs from benign lesions, while the bleeding from cancer is characteristically of the slow, oozing type. It has been estimated, however that from 5 to 15 per cent of massive gastric hemorrhages are attributable to cancer. In such cases occult blood is likely to be found in the stools for a considerable period after the acute episode.

Particular search should be made for supraclavicular, cervical, and axillary nodes and for carcinomatous implants along the anterior rectal wall (Blumer's shelf). Demonstration of nodes in these regions or of an epigastric mass are presumptive evidence of a malignant growth.

In carcinoma there is usually a reduction of free acid sometimes to the point of complete anacidity. This is

not an invariable occurrence, however, for normal or excessive amounts of free hydrochloric acid may be associated with cancer. A high acid level is almost always found with ulcer. It was formerly believed that alkalosis was also characteristic of ulcer but experience has proved that while alkalosis is more common in benign obstruction its presence is not a definite sign that no carcinoma exists.

Evidence of liver damage is indicative of metastases, but normal liver function does not mean that the gastric lesion is necessarily benign. Elevation of the blood phosphatase is highly suggestive of malignancy and metastatic spread.

About 25 per cent of all benign ulcers are on the middle half of the lesser curvature, and 80 per cent of the lesions in this location are benign. About 60 per cent of benign ulcers and 50 per cent of all carcinomas of the stomach occur in the prepyloric segment. Lesions of the greater curvature are almost always malignant.

The author believes that the size of the ulcer is of little diagnostic importance, but that its depth may furnish a clue, in that carcinoma rarely penetrates deeply. If it does, it shows other unmistakable evidence of malignancy. In the presence of a benign ulcer, the roentgenogram will usually show radiating folds of mucosa following a fairly normal pattern. In carcinoma the folds are obliterated and the area appears nodular. An associated spastic contraction of the greater curvature opposite the lesion is strongly indicative of its benign nature. Finally cancer rarely develops in a patient with an active duodenal ulcer.

The gastroscope is not infallible in the diagnosis of gastric lesions, since there are 'blind' areas in the cardia and antrum. If an ulcer can be visualized gastroscopically its benign or malignant nature can usually be determined. A benign ulcer is generally clean cut, its edges are somewhat hyperemic, and it is covered by a pearly white membrane. A malignant ulcer is dirty in appearance, its edges are irregular, and areas of necrosis are seen.

Some cases defy diagnosis and observation of the patient under a rigid ulcer regimen must be resorted to. Such observation may not be conclusive, however and evidence of apparent healing may create a false sense of security. Repeated examinations should be made until healing is complete. JOSEPH T DANZER, M D

Leiomyosarcoma of the Stomach, Its Roentgenologic and Gastroscopic Diagnosis and Its Possible Relation to Pernicious Anemia. Rudolf Schindler, Olov A. Blomquist, Harold L. Thompson, and Arthur M. Pettler Surg Gynec & Obst 82 239-252 March 1946

Leiomyosarcoma has been considered one of the rarest tumors of the stomach, comprising approximately 0.1 per cent of all malignant gastric lesions. The authors, having seen 4 cases within a relatively brief period and having collected 94 cases from the literature believe it may be more common than this figure would indicate. Its diagnosis is particularly important because of the favorable surgical prognosis.

Differentiation of leiomyosarcoma from benign leiomyoma is not easy, even on pathologic examination. Tumors apparently benign microscopically have been known to metastasize. Malignant tumors on the other hand, may not form metastases for a long time, but they quickly break through their natural boundaries growing expansively and in part infiltra-

carditis 2 had *lupus erythematosus disseminatus*, 2 had *carcinomatous metastases*, 2 had *bacterial pericarditis* and 1 had *cardiorenal failure*. In all there was roentgen evidence of *diffuse cardiac enlargement*, but only 6 presented the so-called "water bottle" configuration. The most reliable routine procedure was repeated observations for *recession or progression* in the size of the heart which supplied positive information in 10 of the patients. Fluoroscopic studies were recorded in 7 cases. The difference in amplitude of pulsation over the heart margins and the great vessels was not considered definitely diagnostic.

Hydropericardium was induced in 5 cases and in these the diagnosis was conclusive. The pericardial sac is preferably aspirated through the xiphoid area. The needle is inserted in the space between the ensiform cartilage and the left costal margin and is directed backward, upward and toward the left traversing considerable ligamentous tissue before entering the sagging pericardial sac. The usual practice is to aspirate as much fluid as is indicated by conditions present at the time then to instill about 100 c c of filtered air which is followed by roentgenologic examination.

Three illustrative cases are reported.

STEPHEN N. TAGER, M.D.

THE DIGESTIVE SYSTEM

Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula. Harry A. Keener and Robert C. Hickey. *California & West Med* 64: 128-130, March 1946.

At a U. S. Naval Hospital the authors encountered 2 cases of congenital atresia of the esophagus with tracheo-esophageal fistula in 3,630 unselected deliveries over a period of twenty months. Vogt's classification is quoted: Group I complete absence of the esophagus (very rare), Group II blind ending of both upper and lower segments, Group III esophagotracheal communication (between either the upper or lower segment of the esophagus and the trachea or between both esophageal segments and the trachea). In the authors' cases the communication was between the lower segment and the trachea.

The etiology of this condition is still unknown. The clinical picture is a classic one: regurgitation of food, drooling, coughing, dyspnea, and cyanosis. Passage of a rubber catheter usually reveals an obstruction about 12 cm. from the lips. Roentgenograms from the 2 cases reported are typical. With the aid of a radioopaque medium the upper esophageal segment is outlined as a blind pouch. The presence of the fistulous communication with the trachea is indicated by air within the stomach and upper intestine.

Treatment is surgical, consisting in an attempt to ligate the fistula and anastomose the esophageal segments. The authors' patients, however, were regarded as such poor surgical risks that operation was not attempted. They died on the fourth and fifth days.

MAURICE D. SACHS, M.D.

Correlation of Gastroscopic, Roentgenologic, and Pathologic Findings in Diseases of the Stomach. An Analysis of 245 Proved Cases. Edward B. Benedict. *Am J Roentgenol* 55: 251-274, March 1946.

The author has used as the basis of this report 245 cases for which the roentgenologic, gastroscopic and pathologic reports were available.

One hundred and twenty five cases of proved gastric carcinoma are included. In the diagnosis of 67 cases roentgenology and gastroscopy proved equally good, in 3 cases doubtful results were obtained with both methods, in 3 cases both were wrong. In the remaining 52 cases a more accurate or more valuable report was given by the roentgenologist 32 times, by the gastroscopist 20 times. In 25 of the 32 cases where the roentgen ray was more valuable gastroscopy failed to demonstrate the lesion at all. It is evident from an analysis of the cases that both methods of examination are important. Where one fails, the other may be successful. Besides being confirmatory or otherwise gastroscopy may add secondary diagnoses such as gastritis with or without erosions. The greater number of the gastroscopic failures could be attributed to mechanical difficulties.

Fifty cases of proved benign gastric ulcer were analyzed. In 16 cases the roentgen examination and gastroscopy were equally correct and in 9 cases equally doubtful, in 21 cases roentgen examination was superior and in 4 cases gastroscopy was superior. Gastroscopy was attended by the same mechanical difficulties as in the cancer series which accounted for 17 of the 21 cases in which roentgen examination proved superior. These difficulties were met with chiefly in the pyloric region and the lesser curvature of the antrum. It is disappointing to find how many ulcers were missed on gastroscopy, but their location is often in an area that is relatively blind.

Duodenal ulcer is of interest to the gastroscopist chiefly because of the gastritis which usually accompanies it as the duodenum cannot be seen. A source of bleeding may be established when the ulcer is healed or quiescent. Twenty five cases of duodenal ulcer were included in the series but few of these were recent as gastroscopy is now done only for special indications in these cases. Among 8 cases of jejunal ulcer, there was none in which gastroscopy proved superior.

Studies have proved the ability of both the roentgenologist and gastroscopist to diagnose gastritis not only in association with ulcer or cancer but also as an independent entity. In the author's 16 cases the two methods were equally poor on 2 occasions, gastroscopy was superior 9 times and roentgen examination twice. Gastroscopy has unquestioned superiority in differentiating the various types of gastritis.

In 7 cases of benign tumor the two methods of examination were equal in value. Twice the roentgen ray was better and twice gastroscopy was better. We come closer to the correct diagnosis if both methods are used. In considering the 5 cases of lymphoma studied, it seems the best we can hope for is to suspect it occasionally. The diagnostic criteria to look for may be unusually thick rugae, very marked cobblestone mucosa, multiple erosions and ulcerations in various parts of the stomach at different times with or without rigidity or a tumor. Both methods of examination were inconclusive in sarcoma and metastatic carcinoma.

Gastroscopy is indicated in gastric lesions where the diagnosis is in doubt. Patients with bleeding may have negative roentgen findings; gastroscopy may show severe gastritis with erosions and superficial ulcerations. The gastroscopist may be able to differentiate between a benign and malignant lesion and indicate the type of treatment to employ. Gastroscopy supplements the roentgen examination and is in no way competitive. Gastroscopists must strive to bring about improve-

malrotation of the mesentery Vomiting beginning shortly after the child receives its first feeding, is the cardinal symptom If as is usually the case, the obstruction is below the ampulla of Vater, the vomitus is bile-stained and the meconium is acholic With supra-ampullary obstruction, bile is not present in the vomitus but in the meconium Epigastric distention invariably occurs Dehydration, inanition, avitaminosis, etc., are rapidly progressive

Diagnosis rests on the roentgen findings Gas is present in the stomach only, unless an enema has been given, in which event there may be gas in the colon also The authors advise anteroposterior and antero-lateral films with the child inverted and upright If the gastric gas bubble does not change position with changing posture, a fixed congenital deformity may be assumed The duodenum may rupture neonatally and allow meconium to escape into the peritoneal cavity Calcium present in the meconium may then be demonstrable roentgenographically If barium is used in the examination caution must be exercised to prevent its aspiration It may be injected through a small Levine tube and removed by gentle gastric lavage after the roentgen study is completed The barium clearly delineates the dilated stomach and duodenum thereby localizing the obstruction Hypertrophic pyloric stenosis may be differentiated from complete duodenal obstruction by the passage of small amounts of contrast medium into the jejunum

Acute duodenal obstruction in the newborn must be considered a surgical emergency and operation should be performed at once, after adequate preparation The primary object is to relieve the obstruction as quickly and as safely as possible Major procedures such as gastroyejunostomy and cholecystogastrostomy may be required in cases of complete atresia Occasionally all that is necessary is the division of compressing cicatricial bands

Four of the authors' patients died In retrospect it is believed that 3 of these might have been saved by earlier diagnosis and treatment

JOHN A COCKE, M D

Duplication of the Entire Large Intestine (Colon Duplex) Report of Case Harry M Weber and Claude F Dixon Am J Roentgenol 55 319-324, March 1946

The authors report a case of duplication of the large intestine in which the supernumerary intestine had no communication with the small intestine above it nor with the outside via the rectum The supernumerary colon contained an opaque material (probably excreted calcium) and was visible roentgenographically Its course ran parallel to the normal colon lateral to the ascending and descending portions and above the transverse colon

The patient was a woman aged twenty seven who had been having attacks of sharp pain across the lower abdomen accompanied by obstipation At the age of three she had been operated upon for obstruction of the intestine The surgeon relieved what he called a kink in the region of the sigmoid flexure and created an opening into what he then thought was the colon but subsequently came to believe to be a mesenteric cyst At nineteen years of age an operation was performed for acute appendicitis at which time two appendices were removed one of which was gangrenous

At twenty-two a surgeon explored the abdomen because of symptoms of obstruction and tried unsuccessfully to remove the supposed mesenteric cyst The patient was also found to have a double uterus and double cervix

After a roentgen diagnosis was made by the authors, surgical exploration revealed complete duplication of the large intestine There was a large distended blind end in the left side of the pelvis This displaced the rectum well to the right The descending and sigmoid portions of both colons were resected for an extent of 8 to 10 inches A second operation was done later to re-establish the continuity of the two colons by end-to-end anastomosis, producing a colocolostomy in the mid-sigmoid Eight months after the first operation was performed, the patient had only minor abdominal distress Roentgenograms revealed no opaque material in the colon and only small collections of gas along its course

CLARENCE E WEAVER, M D

Redundancy of the Colon. Arnold Galambos and Wilhelmina M Galambos Am J Digest Dis 13 87-101, March 1946

Kantor's definition of the redundant colon is, "one which is too long to fit into the body of its owner without reduplication" Redundancy refers exclusively to the length of the colon Megacolon refers to an increase in its width Both may be present at the same time in varying degrees

Some authors believe that redundancy is relatively infrequent Moeller reports its presence in 2.4 per cent of 744 cases 'of gastro intestinal import' Others have recorded a much higher incidence Redundancy is not a disease of the atonic or hypotonic state, as the redundant loops show no sign of stretching or thinning of the wall It may exist in varying degrees without symptoms

The diagnosis is a roentgenologic problem and may be established by what the authors call a three phase method First a scout film of the abdomen is taken, which may show a pocket of gas-filled bowel far away from the suspected course of the colon, most frequently in the left splenic flexure or subdiaphragmatic region Gas may fill the stomach and colon even though no redundancy is present and a redundant loop may not necessarily contain gas The barium enema study is the second and most important phase of the roentgen examination This will show the size and shape of the colon and reveal the redundancy if present For the third or functional phase the barium meal is employed Where the motor mechanism is normal, the barium will pass through the intestinal canal leaving the redundant loops without a sign of their existence If, however, there is a breakdown in the motor mechanism, evacuation will be incomplete and gas and barium will remain in the redundant loops

As Carman pointed out certain types of frame-structures are consistently associated with definite types of visceral topography just as facial characteristics distinguish races Thus, in the asthenic person all viscera exhibit signs of drooping or ptosis, and this must not be confused with redundancy Megacolon and megasigmoid must also be differentiated

The redundant colon requires as its basic precondition an elongated mesentery and in repeated examinations the colon will assume many bizarre configurations Failure of a loop of bowel to move on several examinations suggests that adhesions are present

tively Infiltration is never of so high a degree as in infiltrative carcinoma and seldom as diffuse as in lymphosarcoma. Since the latter responds to radiation while leiomyosarcoma is relatively radioresistant their distinction is of primary importance. Grossly leiomyosarcoma may (1) grow into the gastric lumen and even become pedunculated, (2) expand within the gastric wall or (3) grow into the omentum and adjoining structures. Ulceration of the overlying mucosa is a frequent finding.

The cardinal clinical manifestations are gastrointestinal hemorrhage leading to anemia epigastric or left upper quadrant pain and an upper abdominal mass. X-ray examination and gastroscopy should at least reveal the presence of a tumor. The findings in each of the present series are described in some detail. In one case the diagnosis of a gastric tumor was missed at one x-ray examination and in one at two x-ray examinations in both cases the tumor was seen gastroscopically and could be demonstrated on repeat x-ray examination by the relief method. Reviewing their cases the authors come to the conclusion that in 3 of the 4 the x-ray diagnosis of a submucosal tumor would not have been entirely impossible. While it must be admitted that in some cases the differentiation from carcinoma roentgenologically is impossible, the x-ray syndrome of filling defect, plus central niche plus fistulas (into the tumor) should be considered as highly suggestive of leiomyosarcoma. In no instance was a correct gastroscopic diagnosis made though in retrospect it is believed that this, too, should have been possible in 3 cases.

In the collected series, x-ray examination revealed a filling defect in 59 per cent, an extrinsic mass was suspected in 18 per cent, stiffness of the gastric wall was observed in 11 per cent, an ulcer niche without filling defect in 8 per cent. In 4 per cent a negative gastrointestinal series was reported. In one case the correct diagnosis of leiomyosarcoma was made (Chaffin West J Surg 46 513, 1938).

Leiomyosarcoma can be cured surgically in a high percentage of cases. Three of the authors' 4 patients are alive and well despite the size of the lesions. The fourth died postoperatively. The entire tumor must be removed, including adjacent involved organs.

A brief discussion of the relation between leiomyosarcoma and pernicious anemia is included. In one case it is suggested that a pernicious anemia may have been the primary condition, leading to the formation of the tumor.

Excellent roentgen illustrations are included.

JAMES C KATTERJOHN M D

Gastroduodenal Invagination Due to a Submucous Lipoma of the Stomach. William H Hobbs and Samuel E Cohen. Am J Surg 71 505-518 April 1946.

The authors' patient was a 61-year-old white woman who had known of the presence of a movable, nontender mass above her umbilicus for the past year. Following a severe attack of vomiting without constipation examination showed a movable epigastric mass measuring about 3×5 cm. Roentgenograms showed lack of filling of the antrum. Barium was retained in the upper half of the stomach and there was almost complete obstruction involving the lower half giving rise to the abrupt sign described below. There was almost complete retention at six hours and

50 per cent retention at forty eight hours. At operation, two thirds of the stomach was found invaginated into the duodenum as far as the ligament of Treitz with the tumor at the head of the intussusception. Reduction was effected by traction and a pedunculated intragastric tumor, $8 \times 8 \times 5$ cm., was found attached to the posterior wall of the stomach. The tumor was resected and proved to be a lipoma. The patient made a good recovery.

Invaginations involving the stomach are the least frequent of intussusceptions in the bowel. The cause is practically always a gastric tumor, usually benign, which, as it is carried forward by peristalsis, pulls the stomach after it.

The authors have collected 41 reports of gastric or gastroduodenal intussusception [some apparently including more than one case]. On this basis they classify intussusception (1) as complete or partial, depending upon whether the entire thickness of the stomach wall or only the mucosa or the tumor is involved, (2) central or lateral, according to whether or not the whole circumference of the stomach is pulled through symmetrically, (3) due to an internal or external mechanism (cases in which the proximal or oral segment ensheathes the distal segment being considered as dependent upon an external mechanism), (4) grades I, II, III, and IV, depending upon the portion of the duodenum reached by the apex of the invagination.

The early symptoms are those of benign gastric tumor. Gallbladder disease may be simulated when the ampulla of Vater is occluded by the tumor or the invagination. Late symptoms are those of acute obstruction. A ball-valve syndrome due to sudden obstruction of the pylorus consists of violent and transitory attacks of vomiting and pain.

The early roentgen findings suggestive of benign tumor of the stomach are (1) a circumscribed filling defect involving the walls rather than the curvatures, (2) obliteration of the rugae in the immediate area of the tumor, (3) normal peristalsis and no retention except with a lesion near the pylorus, (4) absence of niche, incisura or other signs of spasm, (5) close and complete approximation of the walls of the barium filled stomach. Indicative of invagination are (1) a radiolucent area in the bulb, (2) convergent axial striations due to tension on the proximal part of the stomach, (3) parallel transverse striations due to barium in the lumen of the intussusceptum, (4) the so-called 'abrupt sign'—a sharp delineation of the contrast medium running approximately across the middle of the stomach.

The literature on benign gastric tumors is reviewed emphasizing their rarity and the fact that lipomas represent only 3 to 5 per cent of the total.

J L BOYER M D

Complete Duodenal Obstruction in the Newborn. N Frederick Hicken, Spencer Snow, Q B Coray and E J Jackson. Am J Surg 71 461-469 April 1946.

The authors report 5 cases of duodenal obstruction in the newborn with a plea for early surgical intervention. A general discussion of etiology, diagnosis and treatment is given.

The obstruction may be (1) intrinsic due to failure of the primitive ectoderm in the cord stage to become tubulated, or (2) extrinsic due to bands pressure from an overlying high cecum or faulty fixation or

the right side being practically immobile. At each respiration the mediastinum moved in a to and fro direction as a result of the paradoxical or see saw movement of the diaphragm—the left side going down with inspiration while the right side, although appearing to be relatively fixed, was raised a little. The heart was displaced to the left and downward by the mediastinal shift, but the contour was normal. The roentgenogram confirmed the elevation of the diaphragm at the level of the fifth rib on the right. The infant was placed on the right side to splint the injured nerve, oxygen was given continuously, and gavage feeding was instituted. The cyanosis and respiratory distress were relieved to a surprising extent. Roentgen ray and fluoroscopic examination at eleven days of age showed a definite increase in the movement of the right diaphragm and better aeration of the right lung. Three days later it was possible to place the baby on the back and left side for an increasing length of time without respiratory distress. A third roentgen examination, on the sixteenth day, was practically normal and the patient was discharged in good condition on the twenty sixth day. At the age of five months he was in excellent condition and breathed normally. This is the eighth recorded case of diaphragmatic paralysis without accompanying brachial paralysis.

THE SPLEEN

Diagnosis of Lacerated Spleen. Samuel Levine, Leon Solis Cohen, and Ralph Goldsmith. *Am J Surg* 71: 396-400, March 1946.

Traumatic laceration of the spleen is a common and serious injury. Three types of bleeding may occur: (1) immediate massive hemorrhage, due to extensive rupture; (2) slow oozing from small splenic lacerations; and (3) delayed hemorrhage from intracapsular injury. Aside from the local physical signs (shock may be absent) a very significant symptom is pain in the left shoulder aggravated by deep respiration, this may be quite severe. It is due to irritation of the left diaphragm by hemorrhage beneath it.

A flat film of the abdomen in the supine position shows a characteristic triad of signs in most cases: (1) markedly distended stomach, (2) jagged serrated greater curvature of the stomach believed by the authors to be due to infiltration of blood along the gastrosplenic ligaments, and (3) obliteration of the splenic shadow, merging with the perisplenic hematoma. Where hemorrhage is massive, there may also be a depression of the transverse colon separating it from the stomach.

The anatomy and surgical treatment are discussed. Two case reports following sledding injuries in boys are given together with illustrations. The triad of roentgen signs above is not found in injuries to the liver and kidney.

JOHN A COCKE, M.D.

THE MUSCULOSKELETAL SYSTEM

Lumbosacral Roentgenograms of One Hundred Soldiers: A Control Study. Murray M. Friedman, Frederick J. Fischer, and Robert E. Van Demark. *Am J Roentgenol* 55: 292-298, March 1946.

The material for this study consisted of 100 males between the ages of nineteen and thirty nine years, who had never had backache or suffered any injury to the back. The roentgenograms comprised antero-

posterior and lateral projections of the lower lumbar spine and sacrum, right and left semilateral projections with 30 to 45 degree rotation, and a view taken with the tube tilted 30 degrees cephalad, through the sacrum and lumbosacral joint.

Defects of the neural arch of the lower lumbar spine are not uncommon. They consist of an interruption of the bone between the inferior and superior articular processes, the pars interarticularis. It is this that is the underlying lesion contributing to spondylolisthesis. Defects in the pars interarticularis were found in 6 per cent of the spines of the group studied. Four of these showed some degree of spondylolisthesis. One of these showed considerable changes of degenerative arthritis but there was absence of back pain. Figures obtained by others in surveys of various types are quoted.

Asymmetrical facets of the lumbosacral articulations were found in 39 per cent of the group. In only 3 spines were the facets markedly asymmetrical. No evidence of arthritic changes was found about the facets in any instance.

Some degree of narrowing of the lumbosacral joint space was found in 11 of the 100 spines examined. This was marked in only 2 instances. Narrowing of the lumbosacral joint space may be due to degenerative changes in the disk structures and cartilage, herniation of the nucleus pulposus, or disintegration of the annulus fibrosus. Narrowed disk spaces are sometimes found with transitional vertebrae and present themselves as thin sacral disks. Schmorl's node was found in 8 spines.

Marginal bony proliferation of adjacent vertebral borders and osteophyte formation characteristic of osteoarthritis were found in 4 spines. Persistent ossification centers of the inferior articular process were found in 2 instances. As a rule, these are bilateral and are not to be interpreted as fracture. Eleven examples of transitional type vertebrae were found. In general, the role of a long transverse process impinging on the sacrum or ilium as the cause of backache is open to question.

The incidence of spina bifida occulta was 36 per cent in this group of 100 cases.

CLARENCE E. WEAVER, M.D.

Spondylolisthesis: Criteria for More Accurate Diagnosis of True Anterior Slip of the Involved Vertebral Segment. L. H. Garland and S. F. Thomas. *Am. J. Roentgenol* 55: 275-291, March 1946.

The cause of the forward slipping of a vertebral segment is presumed to be the normal stress of weight of the body in some instances combined with occupational strains, trauma, weakening of muscles and ligaments from age or disease, and softening of some of these structures from pregnancy—all in the presence of a defective neural arch. To demonstrate a true slip requires a correctly positioned and exposed lateral roentgenogram of the lumbosacral spine, sometimes in the erect as well as the horizontal position. Oblique views are required to show the defects in the interarticular portions of the neural arch, the angle varying from 35° to 50°.

Examination of roentgenograms of the lumbosacral spine of many hundreds of patients in naval hospitals discloses the fact that a small but significant percentage of persons have a foreshortened fifth lumbar body. The posterior margin of this vertebral body may be

The redundant colon is probably symptomless and goes undiagnosed in the majority of cases. Constipation is said to be present in 70 per cent of cases, but the authors found it no more distressing than, for example, in an average case of neurosis without redundancy. If symptoms occur, they are due to a kink, knuckle or ptosis of some of the loops. The pain becomes severe only when the motor mechanism is faulty. Most of the authors' patients had had at least one abdominal operation, appendectomy being the most common.

The most important problem in connection with redundancy of the colon is the ascertainment of whether or not the case is well compensated, or is one with impending or actually existing failure of motor mechanism. The breakdown in muscular compensatory mechanism will result in partial retention of both fecal matter and gases. Gas retention may result from failure of its transport or of its absorption or it may be newly formed in the stagnating and decomposed fecal material in the redundant loops. Failure to correct by medical measures the damages wrought by this chronic development may necessitate surgical intervention, especially in progressive cases.

JOSEPH T. DANZER, M.D.

Volvulus of the Sigmoid Colon Harold E. Simon, H. R. Senturia, and Thomas B. Keller. *Am J Surg* 71: 550-552, April 1946.

A case of volvulus of the sigmoid colon in a young man is reported, the interesting feature of the case being the complaint of backache without abdominal pain, tenderness or distention. During the year previous to operation the patient had several episodes of intermittent low back pain associated with painful and ineffectual desire to defecate, probably representing episodes of partial or temporary obstruction. He entered the hospital following an attack of such severity that it awakened him at night. Peristalsis was normal and there was no abdominal tenderness or rigidity. Roentgenograms showed a hugely dilated loop of large bowel in the mid abdomen with a fluid level. A barium enema study showed rapid tapering of the rectum to a constriction, with torsion of the rugal folds and filling of a tremendously dilated loop of sigmoid above the constriction.

Operation revealed a twisted loop of sigmoid with a long mesentery. The loop of sigmoid was successfully resected.

J. L. BOYER, M.D.

Volvulus and Gangrene of the Sigmoid Complicated by Manson's Schistosomiasis Meyer Corff. *Pennsylvania M J* 49: 632-636, March 1946.

A diagnosis of volvulus of the sigmoid in a 20-year-old Puerto Rican male was made preoperatively by roentgen examination. At operation the sigmoid loop was found to be gangrenous, more markedly so at the base of each arm where the volvulus had occurred and a Paul-Mikulicz type of resection was done. A long redundant loop of the sigmoid (60 cm.) with a very short mesentery at the base (10 cm.) was thought to have been the probable cause of the volvulus. Microscopic examination of the specimen of bowel removed showed the wall, some of the blood vessels and the lymph nodes to be infested with *Schistosoma mansoni*. Typical lateral spined ova were found embedded in foreign body giant cells, and the question arises as to whether or not irritation of the bowel by the *Schistosoma* causing excessive peristalsis may not also have been an

etiologic factor in producing the volvulus. It was felt that this was possible but unlikely. Following completion of the surgery and treatment of the schistosomiasis with fuadin, the patient returned to duty in good condition approximately four months after the initial operation.

Papilloma of the Gallbladder David Miller. *New England J Med* 234: 473-476, April 4, 1946.

Papilloma of the gallbladder is an uncommon finding and is usually discovered by the radiologist. It takes the form of a small, soft projection from the wall of the gallbladder, composed of branching complex processes of thin stroma covered by columnar cells. It does not seem to bear any relation to carcinoma of the gallbladder. A combination of infection and metabolic disturbance may play an etiologic role.

The symptoms of papilloma are similar to those of chronic cholecystitis and are most commonly encountered in the third decade. Roentgenologically the lesion is demonstrable as a small, discrete, constant radiolucent area within the gallbladder. It rarely is found in the fundus, where stones and adenoma are usually seen. Treatment is surgical.

Three complete case histories are presented.

JOHN B. MCANENY, M.D.

THE DIAPHRAGM

Acute Primary Diaphragmitis (Hedblom's Syndrome) Minas Joannides. *Dis of Chest* 12: 89-110, March-April 1946.

Acute primary diaphragmitis or Hedblom's syndrome is an acute primary myositis of the diaphragm manifested by inspiratory pain on the affected side, limitation of mobility of the lower chest wall, and a tendency to flaring of the costal margin with inspiration. There may be pain in the upper abdominal quadrant and in the homolateral shoulder and trapezius ridge. Roentgen examination shows an elevation of the involved leaf of the diaphragm with restriction or absence of mobility. With healing the dome of the diaphragm becomes flattened and mobility returns. During the course of the disease there may be extension of the inflammatory process to the pleura or to the subphrenic area.

The author has observed 42 cases. Five case histories with illustrations are included in this article. In the differential diagnosis the following are to be considered: acute spontaneous pneumothorax, acute surgical abdomen, basal pneumonitis, pleurodynia, intercostal herpes zoster, intercostal neuralgia, artificial or spontaneous pneumoperitoneum, irritation of the phrenic nerve trunk associated with mediastinal disease, the scalenus syndrome, acute spasm of the diaphragm, pulmonary atelectasis.

HENRY K. TAYLOR, M.D.

Right-Sided Transient Paralysis of the Diaphragm in a Newborn Infant. Case Report. J. Victor Greenebaum and Forest G. Harper. *J Pediat* 28: 483-487, April 1946.

A case of transient paralysis of the right side of the diaphragm due to so-called isolated phrenic nerve injury in a newborn infant is reported. Signs of respiratory distress and cyanosis appeared on the fourth day of life. Fluoroscopy on the seventh day showed that the baby was breathing with only the left side of the chest.

the right side being practically immobile. At each respiration the mediastinum moved in a to-and-fro direction as a result of the paradoxical or see-saw movement of the diaphragm—the left side going down with inspiration while the right side although appearing to be relatively fixed, was raised a little. The heart was displaced to the left and downward by the mediastinal shift, but the contour was normal. The roentgenogram confirmed the elevation of the diaphragm, at the level of the fifth rib on the right. The infant was placed on the right side to splint the injured nerve, oxygen was given continuously, and gavage feeding was instituted. The cyanosis and respiratory distress were relieved to a surprising extent. Roentgen-ray and fluoroscopic examination at eleven days of age showed a definite increase in the movement of the right diaphragm and better aeration of the right lung. Three days later it was possible to place the baby on the back and left side for an increasing length of time without respiratory distress. A third roentgen examination on the sixteenth day, was practically normal and the patient was discharged in good condition on the twenty-sixth day. At the age of five months he was in excellent condition and breathed normally. This is the eighth recorded case of diaphragmatic paralysis without accompanying brachial paralysis.

THE SPLEEN

Diagnosis of Lacerated Spleen. Samuel Levine, Leon Solis Cohen, and Ralph Goldsmith. *Am J Surg* 71: 396-400, March 1946.

Traumatic laceration of the spleen is a common and serious injury. Three types of bleeding may occur: (1) immediate massive hemorrhage, due to extensive rupture, (2) slow oozing from small splenic lacerations, and (3) delayed hemorrhage from intracapsular injury. Aside from the local physical signs (shock may be absent), a very significant symptom is pain in the left shoulder aggravated by deep respiration, this may be quite severe. It is due to irritation of the left diaphragm by hemorrhage beneath it.

A flat film of the abdomen in the supine position shows a characteristic triad of signs in most cases: (1) markedly distended stomach, (2) jagged serrated greater curvature of the stomach, believed by the authors to be due to infiltration of blood along the gastrosplenic ligaments, and (3) obliteration of the splenic shadow, merging with the perisplenic hematoma. Where hemorrhage is massive there may also be a depression of the transverse colon, separating it from the stomach.

The anatomy and surgical treatment are discussed. Two case reports following sledding injuries in boys are given together with illustrations. The triad of roentgen signs above is not found in injuries to the liver and kidney.

JOHN A. COCKE, M.D.

THE MUSCULOSKELETAL SYSTEM

Lumbosacral Roentgenograms of One Hundred Soldiers: A Control Study. Murray M. Friedman, Frederick J. Fischer, and Robert E. Van Demark. *Am J Roentgenol* 55: 292-298, March 1946.

The material for this study consisted of 100 males between the ages of nineteen and thirty-nine years, who had never had backache or suffered any injury to the back. The roentgenograms comprised antero-

posterior and lateral projections of the lower lumbar spine and sacrum, right and left semilateral projections with 30 to 45 degree rotation, and a view taken with the tube tilted 30 degrees cephalad, through the sacrum and lumbosacral joint.

Defects of the neural arch of the lower lumbar spine are not uncommon. They consist of an interruption of the bone between the inferior and superior articular processes, the pars interarticularis. It is this that is the underlying lesion contributing to spondylolisthesis. Defects in the pars interarticularis were found in 6 per cent of the spines of the group studied. Four of these showed some degree of spondylolisthesis. One of these showed considerable changes of degenerative arthritis but there was absence of back pain. Figures obtained by others in surveys of various types are quoted.

Asymmetrical facets of the lumbosacral articulations were found in 39 per cent of the group. In only 3 spines were the facets markedly asymmetrical. No evidence of arthritic changes was found about the facets in any instance.

Some degree of narrowing of the lumbosacral joint space was found in 11 of the 100 spines examined. This was marked in only 2 instances. Narrowing of the lumbosacral joint space may be due to degenerative changes in the disk structures and cartilage, herniation of the nucleus pulposus or disintegration of the annulus fibrosus. Narrowed disk spaces are sometimes found with transitional vertebrae and present themselves as thin sacral disks. Schmorl's node was found in 8 spines.

Marginal bony proliferation of adjacent vertebral borders and osteophyte formation characteristic of osteoarthritis were found in 4 spines. Persistent ossification centers of the inferior articular process were found in 2 instances. As a rule these are bilateral and are not to be interpreted as fracture. Eleven examples of transitional type vertebrae were found. In general, the role of a long transverse process impinging on the sacrum or ilium as the cause of backache is open to question.

The incidence of spina bifida occulta was 36 per cent in this group of 100 cases.

CLARENCE E. WEAVER, M.D.

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The cause of the forward slipping of a vertebral segment is presumed to be the normal stress of weight of the body in some instances combined with occupational strains, trauma, weakening of muscles and ligaments from age or disease, and softening of some of these structures from pregnancy—all in the presence of a defective neural arch. To demonstrate a true slip requires a correctly positioned and exposed lateral roentgenogram of the lumbosacral spine, sometimes in the erect as well as the horizontal position. Oblique views are required to show the defects in the interarticular portions of the neural arch, the angle varying from 35° to 50°.

Examination of roentgenograms of the lumbosacral spine of many hundreds of patients in naval hospitals discloses the fact that a small but significant percentage of persons have a foreshortened fifth lumbar body. The posterior margin of this vertebral body may be

slightly forward but its anterior margin is not displaced. The authors state that this is not to be regarded as a true slip. To judge forward displacement of the fifth lumbar body they use a line drawn perpendicular to the upper surface of the sacrum, at its anterior superior margin. Normally the anterior inferior margin of the fifth lumbar body lies from 1 to 8 mm behind this line. In any definite degree of spondylolisthesis, the anterior inferior margin of the displaced body always touches or lies in front of the line, in the authors' experience. In a few cases certain anatomical variations and defects may render the establishment of this line difficult or impossible.

In a review of 170 consecutive lumbosacral roentgen examinations, a potentially significant foreshortening of the last lumbar segments was found in 25, or 14.7 per cent. In 15 of these no neural arch defects were present but the posterior edge of the last lumbar body lay from 1 to 3 mm ventral to the plane of that of the first sacral. In the other 9, arch defects were present but in only 4 was the anterior margin of the fifth lumbar body ventral to the test line.

It may be stated that, in general, if the fifth lumbar body is normally "rectangular" in shape and proportionate in size to its adjacent segments, there is a slip only when its anterior margin reaches or passes the perpendicular test line drawn from the first sacral. If the fifth lumbar body is foreshortened (especially caudally) and its shape in lateral projection is hatchet-like, the relation of its posterior margin to that of the first sacral segment cannot be relied upon for the detection of slip.

Neural arch defects were present in 11.7 per cent of the entire series of 170 cases referred for lumbosacral spine examinations. Eighty per cent of cases of spondylolisthesis involve the fifth lumbar body, most of the remaining 20 per cent involve the fourth. In 95 per cent of true olsthesis the arch defects are bilateral.

CLARENCE E. WEAVER, M.D.

Spondylitis Ankylopoietica. L. J. A. Parr and Eva Shipton. M. J. Australia 1: 277-290, March 2, 1946.

This long paper on spondylitis ankylopoietica, known also by such names as Marie-Strümpell arthritis, von Bechterew's spondylitis, and spondylitis rhizomélée, reviews the literature and reports a study of a personal series of cases covering all phases of the disease including roentgen diagnosis and radiotherapy. In the American literature the authors have found some confusion of this disease with rheumatoid arthritis of the spine, which is a different clinical entity. Gilbert Scott used the term adolescent spondylitis since he believed that the pathological process which causes the condition always begins in early adult life, though symptoms may be delayed until late middle age.

Pathological studies on this condition are somewhat limited. The current view seems to be that the disease begins in the apophyseal joints, whereas Scott stressed the initial involvement of the sacroiliac joints, at least from a radiographic point of view. Most of the cases studied exhibit the final phases of the disease, with bony ankylosis of both the sacroiliac and apophyseal joints, calcification of the anterior and posterior longitudinal ligaments and of the ligamentum flavum, decalcification of the vertebrae, and in some instances extension to the shoulder and hip joints.

So far there has been no definite etiology established

for this disease. The fairly frequent occurrence of an associated iritis (in Europe) is suggestive of a tuberculous origin in some cases. Not infrequently there is a history of a gonorrheal infection. Some authors recognize two types of the condition: one of slowly developing insidious onset and the other a more rapidly progressive or fulminating type almost invariably associated with a generalized infection. All stress the fact that the disease attacks vigorous healthy young people with a high predominance of males.

In the typical case there is a "prespondylitic" stage without definite localizing signs. The initial symptoms may closely resemble those of acute sciatica and in many cases sacroiliac involvement is masked by the pain along the distribution of the sciatic nerve. The pain in the lumbar region may radiate down the back of both thighs as far as the knees and such a distribution in a young man or woman should immediately raise the question of ankylosing spondylitis. Morning stiffness which disappears on arising and moving around but which may recur if rest is taken during the day is another common symptom. In the second stage of the disease the four cardinal symptoms and signs are rigidity, deformity, affection of the root articulations and sensory and motor changes due to pressure on a nerve root.

Investigation of the serum calcium content shows very little deviation from the normal even in the presence of pronounced decalcification. Scott regarded the decalcification which is present as a purely local phenomenon, in contrast to the generalized decalcification seen in rheumatoid arthritis.

The ankylosis may be either fibrous or bony. The fibrous state may remain for a variable period of years before bony union occurs. The most valuable test to gauge the activity of the condition is estimation of the blood sedimentation rate, which generally parallels the severity and stage of the disease.

The diagnosis of advanced disease is almost immediately apparent radiologically. The chief interest lies in determination of the site of initial involvement. The authors quote Oppenheimer, Scott and others in this connection. Their own conclusion is that although the x-ray appearance makes possible verification of the clinical diagnosis and may partially reveal the degree of involvement, absence of positive radiographic evidence in the early stages of the disease should not be regarded as disproving its presence. The clinical evidence, stiffness of the back and difficulty of motion with limitation of some of the back motions, is of more significance than the lack of radiological evidence.

The differential features distinguishing spondylitis ankylopoietica from hypertrophic arthritis of the spine, spondylitis associated with inflammatory and infectious diseases, spondylolisthesis and Kummel's disease, postural deformity, primary or secondary malignant disease of the spine, Parkinson's disease, osteitis deformans, and tuberculous sacroiliitis are presented. The most serious error in diagnosis that can be made in the early stages of the disease is to confuse the symptoms of incipient spondylitis with those of tuberculous hip joint disease, leading to fixation of the pelvis and hip joints in a plaster cast with resultant ankylosis.

The treatment of ankylosing spondylitis is considered under several headings. Gilbert Scott's wide field roentgen technic, which is quite different from ordinary deep x-ray therapy, is described. Scott subjected the whole trunk to irradiation from one direction at each

treatment, using 130 kv p, 5 ma, 3 mm Al filter, for a dose of 60 to 100 r, the distance from the tube to the patient being 17 to 20 inches. Treatment once or twice a week is usually required, with an interval of two or three weeks after ten to twelve treatments. The authors treated 38 cases by this method. Treatment was unsatisfactory in 2-4 patients had relapses but responded to subsequent treatment, 32 showed improvement in some cases amounting to apparent cure. Patience and persistence on the part of the doctor and the patient are essential for success. Some patients show rapid improvement after the first course of treatment even if the total dosage is less than 600 r, others require two, three or even four courses.

BERNARD S. KALAYJIAN, M.D.

An Analysis of the Klippel-Feil Syndrome C. A. Erskine. Arch Path 41: 269-281, March 1946

A case of Klippel-Feil syndrome is presented. The anatomic basis of this syndrome and its relation to Sprengel's deformity and to certain neurologic disorders is discussed and a possible mechanism whereby such compound defects may take place is considered. It is concluded that the essential features of the cervical deformity are synostosis of two or more cervical vertebrae and flattening and widening of the vertebral bodies. A numerical reduction of the vertebrae is an incidental rather than an essential part of the disorder as in spina bifida. The latter depends largely on the degree of abnormality of the vertebral bodies. There is evidence that the anomaly has a genetic basis. A number of pathologic conditions which have been found in association with the osseous deformity of the syndrome are explained in the light of recent observations in the field of experimental embryology.

Osteomyelitis in Infants Robert A. J. Einstein and Colin G. Thomas Jr. Am J Roentgenol 55: 299-314 March 1946

Osteomyelitis in infants has its origin in the common respiratory diseases of infancy and in umbilical and skin infections. In the majority of cases the causative organism is the hemolytic streptococcus while *Staphylococcus aureus* is the next most common cause. Due to the more spongy texture of bone in infants and the thinner cortex, there is a freer communication between the marrow and the subperiosteal spaces. There is early and extensive periosteal elevation. The periosteum may rupture early, also with the formation of soft tissue abscesses. There is a minimum of bone destruction and sequestration is rare. Pyarthrosis is a common complication. In virulent infections, cartilage as well as the epiphysis is destroyed, with resultant deformities and arrest of growth. Metastatic involvement of other bones is common. Healing occurs rapidly after surgical or spontaneous decompression. Systemic manifestations are usually minimal in infants. Occasionally however there is a septicemia with severe systemic symptoms.

Treatment is general as well as local. Appropriate chemotherapy should be instituted. Any subperiosteal or soft tissue abscess must be adequately drained. Immobilization is necessary. To diagnose pyarthrosis aspiration of the joint is indicated. Development of chronic osteomyelitis is unusual. The mortality rate as given by different observers varies widely.

Röntgenologically the earliest finding is an area of

bone destruction in the metaphysis adjoining the epiphyseal line. A similar area may be seen in the epiphysis. The periosteum of the diaphysis is elevated. Partial or complete epiphyseal separation indicates infection of the epiphyseal cartilage. Healing is evidenced by rapid subperiosteal formation of new bone. There may be delay in epiphyseal growth with resulting deformities.

The authors report ten cases illustrating the various types of osteomyelitis in infants and include progress roentgenograms. Destruction of the epiphyseal cartilage, epiphyseal center and cartilage of the joint seems to be the most common and most serious complication, as it is followed by disturbance in growth of endochondral bone, with ultimate deformity. A persisting sequestrum was seen in only one case. Clinical recovery in all cases was complete.

CLARENCE S. WEAVER, M.D.

Development of Squamous-Cell Carcinomata in the Sinus Tracts of Chronic Osteomyelitis John J. Niebauer. J Bone & Joint Surg 28: 280-285, April 1946

That malignant change will occur in the sinus tract of a draining osteomyelitis has been known, but it is seldom encountered. The change is most frequently seen between the ages of forty and sixty, in patients who have had a draining sinus for twenty to fifty years.

Roentgenographic evidence of malignant change is lacking until the bone is invaded, when there may be destruction of the sclerotic bone. A positive diagnosis is made by biopsy, the section being taken from deep in the sinus tract.

Amputation is the best method of treating these complicated lesions.

Two case histories are presented with reproductions of the radiographs and microscopic sections.

JOHN B. MCANENY, M.D.

Osteonephropathy. A Report of Two Cases Boland Hughes and Gerhard J. Gislason. J Urol 55: 330-341 April 1946

In brief the clinical picture of osteonephropathy or renal rickets is that of a stunted and deformed child suffering from diminished renal function and severe acidosis with alteration of calcium and phosphorus metabolism. The bone changes may vary from marked deformities with the gross characteristics of infantile rickets to simple osteoporosis or osteomalacia. Almost all patients are retarded in growth. Urinary symptoms vary from polyuria to frank obstructive uropathies. Abnormalities of calcium and phosphorus metabolism are always present, the blood level of the former being low and of the latter high. Blood chemistry findings vary with the degree of renal insufficiency.

The exact underlying physiopathological relations between the various manifestations of this syndrome are little understood but four hypotheses are given. The first postulates impaired ability of the kidneys to excrete the waste endogenous phosphates which are then excreted through the intestinal mucosa where they combine with ingested calcium preventing its absorption and thus causing a calcium deficiency in the body with bone damage. Overactivity of the parathyroid, possibly in conjunction with poor excretion of phosphorus, leading to an upset calcium-phosphorus balance is another theory but some observers deny the role of the parathyroid glands. A third view postulates

a pituitary diencephalon lesion acting through the autonomic nervous system, and a fourth attributes the osseous changes to the prolonged acidosis from poor renal function. It may well be that these various factors overlap thus producing the varied manifestations which are observed.

The classification of osteonephropathies proposed by Rule and Grollman (Ann Int Med 20 63 1944 Abst in Radiology 43 312 1944) is given. The most important group is that due to primary urinary tract disturbances, which includes renal disease with or without associated anatomical change.

Two case reports are given, representative of two types of osteonephropathy: one secondary to obstruction of the left upper urinary tract together with congenital absence of the right kidney, the other secondary to tubular disease of the hyperchloremic type.

It is emphasized that while the patient may present himself to various specialists depending on which phase of the symptom complex predominates, the underlying pathology is renal.

ARTHUR W. PRIDE, M.D.

Osteoid Osteoma Willis M. Weeden and Joseph J. Oliva. Am J Surg 71 558-559 April 1946.

A case of osteoid osteoma arising from the middle third of the right ulna in a 27-year-old white male is presented. The lesion first described by Jaffe, is believed to be a small, benign, slowly growing osteogenic tumor, composed of osteoid tissue which later becomes calcified and converted into hypercalcified atypical bone. This nidus of intramedullary osteoid tissue characteristically produces an excessive bone reaction about it. As it progresses, this sclerotic new bone formation may obscure the nidus on the roentgenogram. In the present case, the true nature of the condition was brought out by overexposing the film. Though the diagnosis is usually made roentgenographically, the condition should be suspected clinically in young adults presenting localized bone pain of some months' duration. Osteoid osteoma must be differentiated from bone abscess, chronic sclerosing non-suppurative osteomyelitis, osteoma, syphilitic osteoperiostitis and early sclerosing osteogenic sarcoma.

JOHN H. FREED, M.D.

Sarcoid of Bone Report of a Case. C. D. L. Cro-mar, D. R. Murphy and C. M. Cardner. J Bone & Joint Surg 28 294-298 April 1946.

Sarcoid of bone is usually found in young adult males. It is of insidious onset, usually involving the bones of the hands and feet. Pain may be present in the early stages.

Three types are observed showing (1) diffuse mottling or speckling of bone with slight expansion of the cortex, (2) punched out areas in the bone, suggesting cysts, (3) loss of bone density and a latticework appearance without alteration of bone contour. Although many observers regard the disease as atypical tuberculosis, there is little direct evidence to support this belief.

Bone sarcoid must be differentiated from dactylitis, tuberculosis, leprosy, syphilis, gout and traumatic cysts. There is no specific treatment.

The present report concerns a soldier hospitalized in 1944 for an upper respiratory condition. He complained of a painful left wrist dating back to 1941 and an x-ray examination was made. The film revealed cyst-

like areas in the triangular greater multangular, and capitate, the distal end of the radius, and the proximal ends of the second and third metacarpals. Biopsy showed sarcoid tissue. JOHN B. McANENY, M.D.

March Fractures of the Foot. Care and Management of 692 Patients Abraham Bernstein, Marvin Childers, Maurice C. Archer, Kermit W. Fox and Joseph R. Stone. Am J Surg 71 355-362 March 1946.

The authors add to their 1944 report of 307 cases of march fracture of the foot (J Bone & Joint Surg 26 743, 1944 Abst in Radiology 44 811 1945) 692 further cases. Diagnostic criteria are (1) point tenderness over the dorsum of the involved metatarsal, (2) pain in the metatarsal area upon manipulation of the toe, (3) swelling, (4) lump and (5) rarely crepitus. Early roentgenograms may fail to reveal a fracture line but periosteal thickening over the medial aspect of the distal and middle thirds of the metatarsal may be seen. Later a fracture may be apparent and large amounts of callus on both sides of the shaft. Margins of the bone at the fracture site will appear hazy and indistinct. Extreme care must be taken in the interpretation of wet films, because it is here that these fractures are frequently missed.

Dodd's conception of a shortened metatarsal (congenitally) as a significant etiological factor is not substantiated by the authors. One hundred normal feet chosen at random were compared with the present series and no variation in the lengths was noted.

In the 692 cases studied 724 fractures were distributed as follows: 3d right 224, 2nd right 181, 3d left 130, 2nd left 138, 4th right 16, 4th left 9, 5th right 3, 1st right 2 and 5th left 1.

Details of treatment were discussed in the earlier article. In the new series 634 patients were treated while ambulatory and 58 had to be hospitalized. No one had been discharged for march fracture. It is interesting to note that the highest incidence of these fractures occurred in the sixth to tenth week of the training period.

JAMES C. KATTERJOHN, M.D.

March Fracture of the Inferior Pubic Ramus P. V. McCarthy and R. E. Van Demark. Mil Surgeon 98 233-235 March 1946.

During a period of less than a year the authors observed 4 cases of march fracture of the inferior pubic ramus, two of these cases one with bilateral involvement are recorded here.

GYNECOLOGY AND OBSTETRICS

Recurrent Placenta Previa and the Significance of Placentography as a Diagnostic Criterion Monrad E. Aaberg. Am J Obst & Gynec 51 578-580 April 1946.

In a review of the literature the author found only 10 reported cases of recurrent placenta praevia in successive pregnancies and one case in non successive pregnancies. He presents two new cases, one of each type. In the first case a marginal placenta praevia was present in the patient's first pregnancy, in 1940, and a complete placenta praevia in her third pregnancy in 1943. In each instance there was some vaginal bleeding and in each placentography showed the placenta low on the posterior wall of the uterus. In the second

case placenta praevia was present in the patient's seventh and eighth pregnancies—marginal in the former and complete in the latter. The implantation was low on the anterior uterine wall.

The following criteria are offered as making possible a more accurate interpretation of soft-tissue films facilitating an earlier diagnosis of placenta praevia. First, if the placenta cannot be visualized on the anterior or posterior uterine wall a diagnosis of complete placenta praevia should be made and confirmed by vaginal examination. Second, when the maximum thickness of the placenta is visualized at or below the equator of the uterus on the anterior uterine wall it is very likely to be a placenta praevia. The likelihood of complete praevia increases proportionately with the distance of the maximum thickness of the placenta below the equator of the uterus. Third, when the placenta is visualized low on the posterior wall displacing the presenting part 3 cm or more from the tip of the sacral promontory or from the base of the fifth lumbar vertebra a diagnosis of placenta praevia should be accepted and corroborated by vaginal examination.

In the author's clinic soft tissue films are taken in all cases of vaginal bleeding during the last trimester of pregnancy unless the patient is in shock from massive hemorrhage. When the placenta is visualized high in the fundus, routine vaginal examinations may be deemed unnecessary. When the placenta is perceived below the equator of the uterus or not seen at all, prompt vaginal examination in an operating room prepared for immediate cesarean section is essential to corroborate the diagnosis.

BERNARD S KALAJIAN, M D

Early Clinical and Roentgenologic Diagnosis of Anencephaly. Catherine W Blumberg and George Teplick. *Am J Obst & Gynec* 51: 571-574 April 1946.

Reported cases of anencephaly diagnosed before delivery and confirmed by x-ray examination are few in number. In most cases suspicion of the defect was not entertained until about the seventh month of gestation at which time there was usually rapid enlargement of the uterus because of hydramnios. Fetal heart tones, as a rule, are absent or indistinct, which may be due in part to lack of innervation of the heart muscle, fetal movement is not felt subjectively or on palpation and when movement does occur, it may be of the exaggerated spasmodic or convulsive type accounting for complaints of abdominal pain, which are more common with this abnormality than in normal pregnancy.

The authors' patient was presumably in the fifth month of pregnancy when she was first examined though the history was vague. She had felt no fetal movements and no fetal heart tones or uterine souffle could be heard. A roentgenogram at this time showed a fetus of four to four and a half months, with two small ossified knobs in place of a skull. The uterine shadow was well outlined and larger than to be expected with a fetus of this size corroborating the clinical impression of hydramnios. Repeated films made several days later verified the diagnosis of anencephaly with hydramnios and showed surprising increase in the size of the uterus. Twelve days later the size was that of a seven months pregnancy. A few days after this the membranes were ruptured uterine contractions occurred and a macerated anencephalic fetus was extracted with some diffi-

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BERNARD S KALAJIAN, M D

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The various types of anomaly encountered are discussed in detail with their treatment. The most frequent abnormality was reduplication of the renal pelvis and ureter occurring in 35 patients. The next most frequent was congenital hydronephrosis found in 21 patients in most instances the result of aberrant blood vessels. There were 7 instances of unilateral hyperplastic kidney, and 5 of renal ectopia in one of which there was associated duplication of ureter and pelvis. Polycystic disease and horseshoe kidney also were encountered. Roentgenograms of many cases are presented.

In general renal lithiasis, pyelonephritis, and hydronephrosis were the conditions superimposed on the renal anomalies. The authors believe that when such conditions complicate a congenital anomaly, the men are unfit for tropical duty as many cases showed exacerbations under the strenuous conditions of military service. Twenty one of the present series required operation.

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Supernumerary Kidney with Ureter Opening into Vagina. Donald N Headings and Rufus E Palmer. *Am J Surg* 71: 370-373 March 1946.

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a pituitary diencephalon lesion acting through the autonomic nervous system and a fourth attributes the osseous changes to the prolonged acidosis from poor renal function. It may well be that these various factors overlap, thus producing the varied manifestations which are observed.

The classification of osteoneuropathies proposed by Rule and Grollman (Ann Int Med 20 63 1944 Abst in Radiology 43 312, 1944) is given. The most important group is that due to primary urinary tract disturbances which includes renal disease with or without associated anatomical change.

Two case reports are given representative of two types of osteoneuropathy: one secondary to obstruction of the left upper urinary tract together with congenital absence of the right kidney, the other secondary to tubular disease of the hyperchloremic type.

It is emphasized that while the patient may present himself to various specialists, depending on which phase of the symptom complex predominates the underlying pathology is renal.

ARTHUR W. PRYDE, M.D.

Osteoid Osteoma Willis M. Weeden and Joseph J. Oliva. Am J Surg 71 558-559, April 1946.

A case of osteoid osteoma arising from the middle third of the right ulna in a 27-year-old white male is presented. The lesion, first described by Jaffe, is believed to be a small, benign, slowly growing osteogenic tumor, composed of osteoid tissue which later becomes calcified and converted into hypercalcified atypical bone. This nidus of intramedullary osteoid tissue characteristically produces an excessive bone reaction about it. As it progresses this sclerotic new bone formation may obscure the nidus on the roentgenogram. In the present case the true nature of the condition was brought out by overexposing the film. Though the diagnosis is usually made roentgenographically the condition should be suspected clinically in young adults presenting localized bone pain of some months' duration. Osteoid osteoma must be differentiated from bone abscess, chronic sclerosing non-suppurative osteomyelitis, osteoma, syphilitic osteoperiostitis and early sclerosing osteogenic sarcoma.

JOHN H. FREED, M.D.

Sarcoid of Bone Report of a Case. C. D. L. Cromar, D. R. Murphy and C. M. Gardner. J. Bone & Joint Surg 28 294-298 April 1946.

Sarcoid of bone is usually found in young adult males. It is of insidious onset usually involving the bones of the hands and feet. Pain may be present in the early stages.

Three types are observed showing (1) diffuse mottling or speckling of bone with slight expansion of the cortex, (2) punched out areas in the bone suggesting cysts, (3) loss of bone density and a latticework appearance without alteration of bone contour. Although many observers regard the disease as atypical tuberculosis there is little direct evidence to support this belief.

Bone sarcoid must be differentiated from dactylitis tuberculosa, leprosy, syphilis, gout and traumatic cysts. There is no specific treatment.

The present report concerns a soldier hospitalized in 1941 for an upper respiratory condition. He complained of a painful left wrist dating back to 1941 and an x-ray examination was made. The film revealed cyst-

like areas in the triangular greater multangular, and capitate the distal end of the radius and the proximal ends of the second and third metacarpals. Biopsy showed sarcoid tissue. JOHN B. McAVENY, M.D.

March Fractures of the Foot. Care and Management of 692 Patients Abraham Bernstein, Marvin Childers, Maurice C. Archer, Kermit W. Fox, and Joseph R. Stone. Am J Surg 71 355-362 March 1946.

The authors add to their 1944 report of 307 cases of march fracture of the foot (J. Bone & Joint Surg 26 743, 1944 Abst in Radiology 44 611 1944) 692 further cases. Diagnostic criteria are (1) point tenderness over the dorsum of the involved metatarsal, (2) pain in the metatarsal area upon manipulation of the toe, (3) swelling, (4) limp and (5) rarely crepitus. Early roentgenograms may fail to reveal a fracture line but periosteal thickening over the medial aspect of the distal and middle thirds of the metatarsal may be seen. Later a fracture may be apparent and large amounts of callus on both sides of the shaft. Margins of the bone at the fracture site will appear hazy and indistinct. Extreme care must be taken in the interpretation of wet films because it is here that these fractures are frequently missed.

Dodd's conception of a shortened metatarsal (congenitally) as a significant etiological factor is not substantiated by the authors. One hundred normal feet chosen at random were compared with the present series and no variation in the lengths was noted.

In the 692 cases studied 724 fractures were distributed as follows: 3d right 224, 2nd right 181, 3d left 150, 2nd left 138, 4th right 16, 4th left 9, 5th right 3, 1st right 2 and 5th left 1.

Details of treatment were discussed in the earlier article. In the new series 634 patients were treated while ambulatory and 58 had to be hospitalized. No one had been discharged for march fracture. It is interesting to note that the highest incidence of these fractures occurred in the sixth to tenth week of the training period. JAMES C. KATTERJOHN, M.D.

March Fracture of the Inferior Pubic Ramus. P. V. McCarthy and R. E. Van Demark. Mil Surgeon 98 233-235 March 1946.

During a period of less than a year the authors observed 4 cases of march fracture of the inferior pubic ramus: two of these cases one with bilateral involvement are recorded here.

GYNECOLOGY AND OBSTETRICS

Recurrent Placenta Previa and the Significance of Placentography as a Diagnostic Criterion. Monrad E. Aaberg. Am J Obst & Gynec 51 578-580 April 1946.

In a review of the literature the author found only 10 reported cases of recurrent placenta praevia in successive pregnancies and one case in non-successive pregnancies. He presents two new cases, one of each type. In the first case a marginal placenta praevia was present in the patient's first pregnancy in 1940 and a complete placenta praevia in her third pregnancy in 1943. In each instance there was some vaginal bleeding and in each placentography showed the placenta lying on the posterior wall of the uterus. In the second

case placenta praevia was present in the patient's seventh and eighth pregnancies—marginal in the former and complete in the latter. The implantation was low on the anterior uterine wall.

The following criteria are offered as making possible a more accurate interpretation of soft-tissue films, facilitating an earlier diagnosis of placenta praevia. First if the placenta cannot be visualized on the anterior or posterior uterine wall a diagnosis of complete placenta praevia should be made and confirmed by vaginal examination. Second, when the maximum thickness of the placenta is visualized at or below the equator of the uterus on the anterior uterine wall it is very likely to be a placenta praevia. The likelihood of complete praevia increases proportionately with the distance of the maximum thickness of the placenta below the equator of the uterus. Third when the placenta is visualized low on the posterior wall, displacing the presenting part 3 cm. or more from the tip of the sacral promontory or from the base of the fifth lumbar vertebra a diagnosis of placenta praevia should be accepted and corroborated by vaginal examination.

In the author's clinic soft tissue films are taken in all cases of vaginal bleeding during the last trimester of pregnancy unless the patient is in shock from massive hemorrhage. When the placenta is visualized high in the fundus, routine vaginal examinations may be deemed unnecessary. When the placenta is perceived below the equator of the uterus or not seen at all prompt vaginal examination in an operating room prepared for immediate cesarean section is essential to corroborate the diagnosis.

BERNARD S. KALAJIAN, M. D.

Early Clinical and Roentgenologic Diagnosis of Anencephaly Catherine W. Blumberg and George Teplick. *Am J Obst & Gynec* 51: 571-574 April 1946.

Reported cases of anencephaly diagnosed before delivery and confirmed by x-ray examination are few in number. In most cases suspicion of the defect was not entertained until about the seventh month of gestation at which time there was usually rapid enlargement of the uterus because of hydramnios. Fetal heart tones as a rule are absent or indistinct which may be due in part to lack of innervation of the heart muscle. Fetal movement is not felt subjectively or on palpation and when movement does occur it may be of the exaggerated spasmodic or convulsive type accounting for complaints of abdominal pain, which are more common with this abnormality than in normal pregnancy.

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but retrograde filling of the ureter disclosed a straight tube like structure lying medial to the right ureter and ending in a blind pouch corresponding to the renal pelvis. Connection to the normal right ureter could not be demonstrated either with radiopaque material or methylene blue. Nephrectomy and complete ureterectomy of the accessory rudimentary kidney was successfully performed. JAMES C KATTERJOHN, M D

Giant Hydronephrosis in a Duplicated Kidney

Philip M Cornwell J Urol 55 238-245, March 1946

A case of giant hydronephrosis in a duplicated kidney, presenting several unusual features, is reported. The patient was a 67-year-old laborer, whose chief complaints were fluid in the abdomen and shortness of breath. The present illness had started four years earlier when the patient first noticed that his abdomen was increasing in size and he began to have periods of marked burning on urination associated with increased frequency and occasional chills and fever. Five weeks previously, he was admitted to another hospital in mild cardiac decompensation. There he was digitalized and given sedatives and mercurial diuretics. The swelling of the abdomen was thought to be due to ascites and a paracentesis was done, with removal of 6 quarts of foul smelling cloudy, greenish yellow fluid. He was then transferred to the Wisconsin General Hospital from which this report comes for further treatment. Here the huge abdominal mass was recognized as being within but not of the general peritoneal cavity. Because of slight changes in the blood picture, it was first thought to be a greatly enlarged spleen and the picture that of an aleukemic phase of lymphatic leukemia.

A flat x ray film of the abdomen suggested however that the mass was not splenic in origin and renal studies were then done. Excretory urography revealed a normally functioning right kidney with a duplication of its pelvis and ureter, and absence of function of the left kidney. A retrograde pyelogram showed the left renal pelvis to be moderately dilated and displaced far laterally with flattening of the calices. Barium studies showed the gastro-intestinal tract to be uninvolved except for marked displacement of the stomach and small bowel to the right and displacement of the descending colon laterally. In view of these findings a diagnosis of a huge retroperitoneal cystic tumor probably a giant hydronephrosis involving the upper half of a duplicated left renal pelvis was made.

A retroperitoneal surgical exploration was advised and carried out after the patient's cardiovascular status had improved. At operation the upper pole of the left kidney was found to consist of a huge cystic mass measuring 22 cm in its greatest dimension with a ureter dilated to the size of the small bowel issuing from its lower portion. The lower pole consisted of a small flattened bit of normal appearing renal tissue intimately connected with the large cystic structure but drained by a second ureter of approximately normal caliber. The left kidney and cystic mass were successfully removed. JOHN H FREED M D

Diverticular or Cavitary Chronic Prostatitis

Alfonso de la Pena and Emilio de la Pena J Urol 55 273-277 March 1946

Diverticular prostatitis is a type of chronic prostatitis with the formation of small abscesses that may rupture

into the urethra, leaving cavities or diverticula with large openings communicating with the urethral canal. The symptoms of this condition are pyuria, hematuria, frequency, sexual disturbance, and pain along the urethra and perineum. Possible complications are intraprostatic vesical, or renal stones and rarely ureteral backflow. Multiple openings from the prostate into the urethra can be seen on urethroscopic examination and pus can frequently be expressed from these on stripping of the gland. Large channels are often seen and with them a median bar due to associated fibrosis. If the openings are too small to be seen directly they may be visualized by urethrocytography. Iodized oil will fill out the cavities which appear on the film in the form of a bunch of grapes or as a single diverticulum with its duct draining into the urethra.

Both congenital and acquired diverticula occur. The former which are seldom seen are usually symmetrical, have a large short outlet, and are often associated with other abnormalities, as spina bifida or patent urachus. Diverticula of the acquired type are of more interest. By retention of septic secretion they may act as a focus of infection. They may also cause bladder neck obstruction as a result of chronic prostatitis in the final stage of which the prostate along with surrounding tissue becomes fibrotic and hard.

Diathermic destruction of the cavities through the urethroscope has been advised. The authors have used deep roentgen therapy over the last ten years with good results in a small number of cases.

ARTHUR W PRIDE M D

Trauma of the Lower Urinary Tract. A Roentgenologic Study

H Stephen Weens, J Harold Newman, and Thomas J Florence. New England J Med 234 357-364 March 14 1946

Injuries of the bladder and posterior urethra are surgical emergencies. The history and physical examination may be sufficient for a diagnosis. Intra-peritoneal rupture of the bladder, however, may show grossly clear urine and hematuria may occur without significant urinary tract injury. Recently urethrogram and cystography have been advised but the correct interpretation has not been sufficiently stressed. For this reason the authors present 7 cases with their observations and reproductions of their films. The cases are briefly as follows:

Case 1 Bloody urine obtained on catheterization. Intravenous pyelogram normal. Retrograde cystogram showed intraperitoneal extravasation.

Case 2 Fracture of the pelvis. Urine bloody. Intravenous pyelogram normal. Intra-peritoneal extravasation demonstrable on retrograde cystogram.

Case 3 Fibrous contraction of the bladder neck with retention relieved by catheter. An attempt at cystoscopy was unsatisfactory and the patient complained of abdominal pain. Rupture of the bladder was suspected and a retrograde cystogram showed intra-peritoneal extravasation.

Case 4 Fractured pelvis. Bloody urine. A cystogram showed contrast medium in the pelvic tissues and exploration revealed a tear in the retropubic space.

Case 5 Fractured pelvis. Bloody urine. Extra-peritoneal extravasation of the contrast medium demonstrable on retrograde cystogram.

Case 6 Pelvic fracture. Bloody urine. Extravasation in the region of the bladder neck demonstrated by retrograde cystography.

Case 7 Fracture of the pelvis Bloody urine Extravasation of the contrast medium in the region of the posterior urethra demonstrated by retrograde cystography

As is seen in this series, intravenous pyelography while it may produce a satisfactory cystogram, is not reliable for the demonstration of injury. The authors suggest retrograde cystography in all patients with possible lower urinary tract injury.

The procedure consists in injecting 20 per cent skiodan, or some other contrast medium, into the urethra with an Asepto syringe. A preliminary roentgenogram is made after the injection of a small quantity of contrast medium. If no abnormality is seen, the bladder is well distended.

In intraperitoneal rupture of the bladder the distended intestinal loops present a characteristic appearance. More important is the band like or linear spread of the medium along the peritoneal reflection of the flanks (paracolic recesses). A full view of the abdomen should be obtained. Rupture of the posterior urethra and extraperitoneal vesical rupture are characterized by diffuse penetration of the medium into the pelvic floor tissues and the prevesical space. In massive extravasations the medium may assume a sunburst-like appearance. Intraperitoneal and extraperitoneal rupture of the urinary bladder may occur but was not encountered in this series.

JOHN B. McANENY, M D

THE SPINAL CORD

The Myelographic Diagnosis of Extramedullary Cervical Spinal Cord Tumors Bernard S Epstein and Leo M Davidoff. *Am J Roentgenol* 55 413-419 April 1946

The roentgenologic diagnosis of spinal cord tumors has rested largely on the presence of pressure effects on the vertebrae. These changes are usually late manifestations. The use of pantopaque myelography permits the diagnosis of intraspinal tumor masses in the cervical canal before visible changes occur in the vertebrae. The authors report myelographic findings in 5 patients with extramedullary tumors of the cervical spinal cord or nerve roots in whom the routine roentgenograms were normal. In 3 of the cases the tumor was a perineural fibroblastoma and in the other 2 a psammomatous meningioma. The neurological findings were variable and did not permit exact localization of the level of the lesion.

In the technique described a motor-driven tilt table which may be tilted 10 degrees head downward, equipped for fluoroscopy and spot film roentgenography is required. Three cubic centimeters of pantopaque is injected into the lumbar subarachnoid space. After the oil gathers in the lumbar sac the head of the table is tilted downward 10 degrees from the horizontal, permitting the oil to ascend to about the 1st lumbar level. The patient then gradually assumes a knee-chest position until the pantopaque reaches the upper thoracic region when he is returned to the prone position. The table is tilted slightly caudad and the oil is allowed to collect in the lower cervical canal.

The diagnosis of cervical spinal canal tumors rests on the presence of filling defects in the advancing head of the pantopaque column. These may assume an arcuate or curvilinear configuration. The defect will be constant on repeated observations. In examination

of the upper cervical spine, passage of pantopaque into the basilar cistern is likely to occur. Usually the oil can be returned to the spinal canal by reversing the patient's position. Two reactions have been noted in patients showing retained droplets of pantopaque in the basilar cistern. The first consisted of vertigo of four days' duration, starting one week after myelography. The second was a headache of two days' duration, starting five days after examination. Both patients had negative cervical myelograms.

H H WRIGHT, M D

THE BLOOD VESSELS

Clubbed Fingers Robert Charr and Paul C Swenson. *Am J Roentgenol* 55 325-330, March 1946

Roentgen studies were made in 6 cases of recent clubbing of the fingers without osteoarthropathy, with a view to demonstrating possible arterial changes. Post-mortem arteriograms in 3 cases, in which a mixture of barium and water was used as the contrast medium, showed that arteries and arterioles were more numerous, their lumens were wider, and the network of arterioles covering the ungual processes was heavier than normal. In 2 other cases infra red photographs of the clubbed fingers also demonstrated increased prominence and number of the superficial vessels. The arteriograms and photographs are reproduced.

The prevailing impression seems to be that clubbing of the fingers is largely a hypertrophy and hyperplasia of the tissues about the terminal phalanges as a result of increased nutrition due to an enhanced peripheral blood flow.

Two of the authors' patients died of fibroid pulmonary tuberculosis and one of anthracosis with superimposed tuberculosis, one was under treatment for advanced bronchiectasis, and one had congenital pulmonary stenosis. The sixth had pulmonary necrosis with erythema of the nail beds and palms and urticaria of the palms.

CLARENCE E WEAVER, M D

Calcified True Aneurism of Left Renal Artery J P Brady and J S Hanten. *Calif & West Med* 64 131-132 March 1946

True calcified aneurysms of the renal artery are rare. To date 72 cases have been reported in the literature. The authors add a further example in which pyelographic studies were made. An incomplete annular shadow was demonstrated near the hilus of the upper pole of the left kidney, and three possible diagnoses were suggested, in the following order of probability: calcified cyst, early new growth with calcified cyst, aneurysm of the renal artery. Because of the second possibility, nephrectomy was done, and two sacculated aneurysms of the renal artery were found. The larger of the two had a shell like wall, partially calcified.

Special attention is called to the defect in the ring-like shadow of calcification representing probably the connection between the aneurysm and the artery. A similar defect appears in films reproduced in other reports and the author suggests that it may be of significance for the differential diagnosis. The form of the shadow, spherical and hollow, should aid in differentiation from calcified lymph nodes, and the fact that it may be shown stereoscopically to be external to the renal parenchyma should exclude a diagnosis of cyst.

MAURICE D SACHS, M D

THE SOFT TISSUES

The Ehlers-Danlos Syndrome John F Holt Am J Roentgenol 55 420-426 April 1946

The Ehlers-Danlos syndrome is a congenital dystrophic anomaly consisting of hyperelasticity and fragility of the skin and blood vessels hypermobility of the joints pseudo-tumors over the bony prominences, and movable nodules beneath the skin It is frequently associated with other developmental anomalies Its etiology is unknown The subcutaneous nodules found in this condition have been described by some as consisting of a spherical, fibrous outer portion, possibly with a zone of calcification, and a fluid inner portion Others describe the nodules as shot like, oil containing cysts surrounded by fibrous or calcified capsules

The author reports the observation of disseminated soft-tissue calcium deposits in the extremities of two sisters presenting typical clinical signs of the syndrome No previous roentgenograms illustrating the calcified subcutaneous nodules appear in the literature In the first case, in a white girl aged 18 roentgenograms of all four extremities showed disseminated, small, rounded discrete calcareous nodules involving either the skin or the immediate underlying tissues In the upper extremities calcifications were most numerous on the extensor surfaces Involvement of the thighs was limited chiefly to the extreme lateral surfaces The calcifications were most numerous in the lower legs, with a predilection for the lateral and medial skin sur-

faces The calcifications have a rather uniform appearance usually with a central zone of relatively increased radiolucency surrounded by a ring like shadow of lime salt

The younger sister, aged 16 was examined because of a tumor involving her left knee Roentgenograms showed a primary malignant neoplasm of the proximal left tibia, and biopsy showed osteochondrosarcoma Initial films, made for bone detail, did not show subcutaneous calcified nodules clearly Subsequent roentgenograms of the surgical specimen following amputation showed calcified subcutaneous nodules fewer in number but of the same configuration and distribution as noted in the previous case

Microscopic examination of the subcutaneous nodules in the surgical specimen revealed that the majority of them contained no calcium deposits but consisted of isolated groups of fat cells tightly compressed within collagenous fibrous capsules Most of the fat cells were necrotic and it is within this tissue that calcium is deposited Uniform increase in elastic tissue is seen in the corium

Phleboliths occurring in hemangiomas show some resemblance to the calcified nodules seen in this condition, but are apt to be distributed throughout the deeper soft tissues and show more variation in size and irregularity in outline The larvae of parasites which may calcify in the muscles of the extremities have peculiarities of shape which should permit differentiation

H H WRIGHT, M D

RADIOTHERAPY

Epithelioma. Report on 1,742 Treated Patients Joseph A Elliott and David G Welton Arch Dermat & Syph 53 307-328 April 1946

The material for this paper is drawn from a group of 2 081 patients seen in private practice in a twenty two-year period Excluding those with lesions of the mucous membrane, Paget's disease, and Bowen's disease as well as those referred for high-voltage roentgen therapy and surgery and a small number who failed to return for treatment the series analyzed consists of 1,742 patients with 1 928 epitheliomas

Of 633 patients who were questioned on this point 37 per cent gave a family history of cancer With more accurate histories this figure would probably be much higher

The authors believe that almost all epitheliomas are preceded by some degenerative change most of them developing from senile keratoses They also discuss at length the etiologic role of sunlight but do not regard their figures on this point as particularly significant, as many of those who were listed as having an indoor occupation (59.4 per cent of the total) actually spent much time out of doors

The lesions observed are divided into three groups small (less than 0.5 cm in surface diameter) 45.6 per cent medium (0.5 to 1.0 cm) 26.4 per cent large (over 1.0 cm) 27.9 per cent The size of the epithelioma was found to play a significant role in the results of treatment Fifty per cent of the authors failures were in lesions exceeding 5.0 cm in diameter

As to clinical form 29.4 per cent are classified as papules 25.6 per cent were nodules and tumors 17.2 per cent superficial ulcers 16.8 per cent deep ulcers 7.2 per cent verrucous lesions 3 per cent cutaneous

horns and senile keratoses with malignant base In 77.8 per cent the lesions occurred on the face

Two hundred and ten of these cases (12 per cent) had been treated before being seen by the authors They believe that radiation used alone in high dosage increases the difficulty of subsequent therapeutic procedures and renders the prognosis less favorable

The method of treatment most often employed by the authors begins with a thorough curettage of all the abnormal tissue This gives valuable information about the depth and extent of the lesion and allows any subsequent therapeutic measure a much greater chance of success The area is then treated by electrocoagulation or desiccation This treated area plus a peripheral margin of skin, is exposed to 600 to 800 r of unfiltered roentgen rays at 105 kv, 5 ma, at a focal skin distance of 22.8 cm This dosage is repeated every four to seven days until 2 400 to 3 000 r are given The time required for healing ranges from four to seven weeks Those who use the combined method as described believe that the cosmetic results are superior to those obtained by superficial radiation alone

A total of 1 052 cases were followed for five years Among these were 1 022 five year cures 15 recurrences and 15 failures, which include 3 deaths Of the 15 recurrences 11 were cured by repeating the treatment or by surgical excision Metastasis developed in only 3 cases

JOSEPH T DANZER, M D

Cancer of the Maxillary Sinus Treated Solely by Deep Roentgen Irradiation J A Mathez J de radiol et d'électrol 27 25-28, 1946

The author recounts the details of several cases of cancer of the maxillary sinus which were given deep

x ray therapy exclusively The duration of life in most of them was short—a few months or a year, but death was attributed to other causes

The attempt to establish the treatment as successful in each of these cases is hardly convincing. Even so intrepid a therapist as Pohle is skeptical of deep therapy in malignant neoplasms of the maxillary sinus, and warns that one must be willing to deliver the very maximum in dosage, among otolaryngologists the method has no standing

In the radium clinic at Cook County Hospital, the abstractor has watched the progress of these antral cancers for several years. The oral surgeon in charge, having given a fair trial to radiotherapy had settled on the following procedure. He removed the anterior wall of the sinus and destroyed the growth with a cautery. The sinus was left open and the radium therapists could then implant as much radium as they deemed advisable. If the growth showed no signs of returning in about a year the surgeon considered constructing a plastic wall and closing the sinus. No case was ever referred for deep x ray therapy alone

PERCY J DELANO, M D

Cancer of the Larynx Five Year Results of Concentration Radiotherapy Max Cutler Arch Otolaryng 43 315-330 April 1946

In a series of 118 consecutive patients with cancer of the larynx treated by irradiation at the Chicago Tumor Institute from April 1938 through December 1942, 42 per cent five year cures and 39 per cent three-year cures were obtained. The principles and technique of the method have been previously described (J A M A 117 1607, Nov 8, 1941 Abst in Radiology 38 635 1942). Concentration radiotherapy is much more intense than the divided dose technique (Coutard method) now generally used and has been successful in certain forms of laryngeal cancer hitherto regarded as incurable by irradiation. When the cords are freely movable or only partly fixed by the tumor curability is high but when they are completely fixed, cure is less common and laryngectomy is indicated. This report shows that patients with intrinsic squamous carcinoma of the larynx too advanced for laryngofissure and requiring total laryngectomy may be cured by irradiation. As the results of irradiation grow better the field for surgery becomes more restricted. Laryngectomy should be limited to intrinsic lesions with complete fixation of the cords in patients who are good surgical risks and have a high life expectancy. Improvements in technique of irradiation and earlier diagnosis should further diminish the necessity of total laryngectomy

Columnar-Cell Carcinoma of the Rectum Treated by Radon Preliminary Report, Sixteen Months After Treatment. P D Braddon M J Australia 1 477 April 6, 1946

A columnar-cell carcinoma of the rectum diagnosed eight months after excision of a rectal polyp in a man of fifty three years was treated by a double-circle radon gold seed implant for a dosage of 6700 r. The rectum was then firmly packed with vaseline gauze to prevent collapse of the treated area and to insure accurate distribution and dosage. The pack was removed after four days, an enema was given, and the rectum was repacked. This treatment was continued for four-

teen days, by which time the residual gamma radiation in the seeds was negligible. At the time of the report, sixteen months following treatment, the patient was in excellent condition and had gained six pounds in weight. Except for a reaction for the first few weeks symptoms had been conspicuous by their absence. There was no general irradiation proctitis. Locally, in the rectal wall, all that could be detected was slight scarring and tethering of the mucosa, with two seeds distinctly palpable

Observations on the Treatment of Adenocarcinoma of the Uterus Laman A Gray, Milton Friedman, and William S Randall Surg, Gynec & Obst 82 386-404, April 1946

The authors record 10 cases of adenocarcinoma of the uterus seen in a three year period, prefacing their presentation with citations of the five year survival rates obtained in various clinics in America and abroad

An instrument called a "hysterostat," designed by one of the authors is described. It is constructed of multiple sections, each the length of a single radium capsule, which can be screwed together in the operating room after the contour of the uterus has been defined, so as to produce a roughly triangular distribution of radium sources within the uterine cavity. It is believed that, because of the adjustability of this device, a more even distribution of radiation can be obtained

Intrauterine radium in doses varying from 6,000 mg hr to 12,480 mg hr, was used preoperatively in 7 patients. When the dosage was greater than 6,000 mg hr two applications were made. An average interval of about forty five days elapsed between the administration of radium and panhysterectomy and bilateral salpingo-oophorectomy

The significant finding was that in 6 of the 7 cases thus treated small islands of viable carcinomatous cells were present in the superficial myometrium. Three patients were found, at operation, to have metastases to the ovaries a point which the authors believe constitutes a strong argument against radiation treatment alone

Various advantages of preoperative irradiation including reduction of intrauterine infection, reduction in size of the uterus immobilization of carcinomatous cells sclerosis of lymphatics and vessels and prevention of recurrence from operative spill are pointed out. Disadvantages include later deleterious effects of radiation increased hospitalization period, late recovery of vitality, diarrhea and urinary frequency

The authors conclude that radiation alone is insufficient in the treatment of uterine adenocarcinoma and that the exact role of preoperative radiation therapy has not been satisfactorily determined

ALTON S HANSEN M D

A Basis for Sympathectomy for Cancer of the Cervix Uteri A de Sousa Pereira Arch Surg 52 260-285, March 1946

The visceral pain of uterine and other cancers can be relieved by section of the lumbar sympathetic trunks, provided the tumor does not extend beyond the anesthetized area. However, a concurrent vasodilation is produced, and the question arises whether the increase in temperature and the better nutritive supply will not accelerate the tumor growth. The author first proves by animal experiment and observations on patients that there is actually an increased flow of blood and a tem-

THE SOFT TISSUES

The Ehlers-Danlos Syndrome John F Holt Am J Roentgenol 55 420-426 April 1946

The Ehlers Danlos syndrome is a congenital dystrophic anomaly consisting of hyperelasticity and fragility of the skin and blood vessels hypermobility of the joints pseudo tumors over the bony prominences, and movable nodules beneath the skin It is frequently associated with other developmental anomalies Its etiology is unknown The subcutaneous nodules found in this condition have been described by some as consisting of a spherical, fibrous outer portion possibly with a zone of calcification and a fluid inner portion Others describe the nodules as shot like, oil-containing cysts surrounded by fibrous or calcified capsules

The author reports the observation of disseminated soft-tissue calcium deposits in the extremities of two sisters presenting typical clinical signs of the syndrome No previous roentgenograms illustrating the calcified subcutaneous nodules appear in the literature In the first case, in a white girl aged 18 roentgenograms of all four extremities showed disseminated, small rounded, discrete calcareous nodules involving either the skin or the immediate underlying tissues In the upper extremities calcifications were most numerous on the extensor surfaces Involvement of the thighs was limited chiefly to the extreme lateral surfaces The calcifications were most numerous in the lower legs, with a predilection for the lateral and medial skin sur-

faces The calcifications have a rather uniform appearance, usually with a central zone of relatively increased radiolucency surrounded by a ring like shadow of lime salt

The younger sister, aged 16, was examined because of a tumor involving her left knee. Roentgenograms showed a primary malignant neoplasm of the proximal left tibia and biopsy showed osteochondrosarcoma Initial films, made for bone detail, did not show subcutaneous calcified nodules clearly Subsequent roentgenograms of the surgical specimen following amputation showed calcified subcutaneous nodules fewer in number but of the same configuration and distribution as noted in the previous case

Microscopic examination of the subcutaneous nodules in the surgical specimen revealed that the majority of them contained no calcium deposits but consisted of isolated groups of fat cells tightly compressed within collagenous fibrous capsules Most of the fat cells were necrotic and it is within this tissue that calcium is deposited Uniform increase in elastic tissue is seen in the corium

Phleboliths occurring in hemangiomas show some resemblance to the calcified nodules seen in this condition but are apt to be distributed throughout the deeper soft tissues and show more variation in size and irregularity in outline The larvae of parasites which may calcify in the muscles of the extremities have peculiarities of shape which should permit differentiation

H H WRIGHT MD

RADIOTHERAPY

Epithelioma Report on 1,742 Treated Patients Joseph A Elliott and David G Welton Arch Dermat & Syph 53 307-328, April 1946

The material for this paper is drawn from a group of 2,081 patients seen in private practice in a twenty two-year period Excluding those with lesions of the mucous membrane Paget's disease, and Bowen's disease, as well as those referred for high-voltage roentgen therapy and surgery and a small number who failed to return for treatment the series analyzed consists of 1,742 patients with 1,928 epitheliomas

Of 633 patients who were questioned on this point, 37 per cent gave a family history of cancer With more accurate histories this figure would probably be much higher

The authors believe that almost all epitheliomas are preceded by some degenerative change most of them developing from senile keratoses They also discuss at length the etiologic role of sunlight but do not regard their figures on this point as particularly significant, as many of those who were listed as having an indoor occupation (59.4 per cent of the total) actually spent much time out of doors

The lesions observed are divided into three groups small (less than 0.5 cm in surface diameter) 45.6 per cent, medium (0.5 to 1.0 cm) 26.4 per cent large (over 1.0 cm) 27.9 per cent The size of the epithelioma was found to play a significant role in the results of treatment Fifty per cent of the authors' failures were in lesions exceeding 5.0 cm in diameter

As to clinical form 29.4 per cent are classified as papules, 25.6 per cent were nodules and tumors 17.2 per cent superficial ulcers 16.8 per cent deep ulcers, 7.2 per cent verrucous lesions 3 per cent cutaneous

horns and senile keratoses with malignant base In 77.8 per cent the lesions occurred on the face

Two hundred and ten of these cases (12 per cent) had been treated before being seen by the authors They believe that radiation used alone in high dosage increases the difficulty of subsequent therapeutic procedures and renders the prognosis less favorable

The method of treatment most often employed by the authors begins with a thorough curettage of all the abnormal tissue This gives valuable information about the depth and extent of the lesion and allows any subsequent therapeutic measure a much greater chance of success The area is then treated by electrocoagulation or desiccation This treated area, plus a peripheral margin of skin is exposed to 600 to 800 r of unfiltered roentgen rays at 105 kv 5 ma at a focal skin distance of 22.8 cm This dosage is repeated every four to seven days until 2,400 to 3,000 r are given The time required for healing ranges from four to seven weeks Those who use the combined method as described believe that the cosmetic results are superior to those obtained by superficial radiation alone

A total of 1,053 cases were followed for five years Among these were 1,022 five year cures, 15 recurrences and 15 failures, which include 3 deaths Of the 15 recurrences 11 were cured by repeating the treatment or by surgical excision Metastasis developed in only 3 cases

JOSEPH T DANZER, MD

Cancer of the Maxillary Sinus Treated Solely by Deep Roentgen Irradiation J A Mather J de radiol et d'electrol 27 25-28 1946

The author recounts the details of several cases of cancer of the maxillary sinus which were given deep

teen days, by which time the residual gamma radiation in the seeds was negligible At the time of the report, sixteen months following treatment, the patient was in excellent condition and had gained six pounds in weight Except for a reaction for the first few weeks, symptoms had been conspicuous by their absence There was no general irradiation proctitis Locally in the rectal wall all that could be detected was slight scarring and tethering of the mucosa, with two seeds distinctly palpable

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With block (28 cases)	
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No improvement	60%
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Metastasis to bone	25%
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The author concludes that, in addition to pain relief, sympathetic block in the early stages of cancer causes an improvement in the healing of the primary lesion rather than the reverse although as he points out the evidence is not final because of the small number of cases.

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All redundant tissues and blood clots are removed from the surface of the tumor so that it receives the full benefit of irradiation. Sodium pentothal and rectal avertin anesthesia are employed to keep the patient

asleep during the roentgen therapy. In addition caudal anesthesia (15 c.c. 2 per cent novocain) is used to relax the bladder wall in order to assure optimal exposure of the tumor. A lead cuff is inserted into the bladder and surrounds the tumor thus protecting the adjacent tissues. The skin surface is likewise protected by lead which is cut out to fit the edge of the lead cuff circling the tumor. Drawings illustrate the various steps in the technique.

More than 40 cases have been treated. At first two doses of 1,800 r were given. There was no difficulty in exposing the tumor at a second operation. At the present time however, 3,300 r are given in one treatment. The physical factors used in the administration of the roentgen therapy are not stated nor are the authors able as yet to furnish definite figures as to their results.

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Toxemia is a characteristic finding and is manifested by fever, loss of weight, sweating, anorexia, malaise and joint symptoms. Anemia is common, being least frequent in chronic lymphoid leukemia. The anemia is variable in type and may be macrocytic particularly in the leukopenic patients. Thrombopenia is common and as a result of this hemorrhage is a frequent symptom. It may be manifested as petechiae, cerebral hemorrhage or bleeding from the intestinal tract. Infection is a frequent occurrence in acute leukemia.

There is a wide variation in the clinical picture in different cases of leukemia due to widespread involvement of almost all tissues of the body and to the effect of toxemia. Of 400 cases of leukemia seen at the Cleveland Clinic the distribution was as follows: (1) acute myeloid or myeloblastic 16.5 per cent, (2) chronic myeloid 24.7 per cent, (3) acute lymphoid or lymphoblastic 15.3 per cent, (4) chronic lymphoid 29.5 per cent.

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Of the 49 patients studied throughout their illness, 28 died and 21 were still under active treatment at the time of this report Twelve patients lived six months or less, 17 lived three years or more, 7 lived more than five years, 2 lived thirteen years, 1 eighteen years, and 1 nineteen years after the initial treatment The average duration of life from the time of instituting treatment was 39.7 months in the lymphogenous group and 32.3 months in the myelogenous group

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DOSAGE

Example of Need for Dermatologic Publicity of Developments in Radiologic Physics
John C Belisario and Robert E Pugh Jr Arch Dermat & Syph 53 115-118 February 1946

One of the authors of this paper purchased a Victoreen r meter in the United States He visited the offices of many dermatologists in this country checking on the dosage used in the treatment of skin lesions He then went to Australia, where he made a study of the dosage used by dermatologists in that country The result of this investigation was published in a paper which appeared in the *Archives of Dermatology and Syphilology* in March 1942 (Abst in Radiology 39 381, 1942)

In that article it was stated that this was the first time a comparison had been made of the dosage used in the two countries, and that a unit of measurement should be established that could be used in both This statement drew the fire of Dr C E Eddy, who in a subsequent article (Arch Dermat Syph 49 250, 1944 Abst in Radiology 43 617, 1944) stated that an accurate international unit of measurement had been established He further stated that the Australian government, with a well equipped, well staffed organization, was willing to calibrate any x ray machine in Australia

The purpose of the present article is to point out that the calibrating equipment was not called to the attention of the dermatologists in Australia As no article on the subject appeared in a dermatologic journal they did not know that this source existed [they might have been informed if dermatologic journals had abstract sections] The authors suggest that physicists should be urged to publish articles in dermatologic magazines dealing with irradiation physics as it concerns the dermatologist

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DOSAGE

Example of Need for Dermatologic Publicity of Developments in Radiologic Physics John C Belisario and Robert E Pugh, Jr Arch Dermat & Syph 53 115-118, February 1946

One of the authors of this paper purchased a Victoreen r meter in the United States He visited the offices of many dermatologists in this country, checking on the dosage used in the treatment of skin lesions He then went to Australia, where he made a study of the dosage used by dermatologists in that country The result of this investigation was published in a paper which appeared in the *Archives of Dermatology and Syphilology* in March 1942 (Abst in Radiology 39 381, 1942)

In that article it was stated that this was the first time a comparison had been made of the dosage used in the two countries and that a unit of measurement should be established that could be used in both This statement drew the fire of Dr C E Eddy, who in a subsequent article (Arch Dermat Syph 49 250, 1944 Abst in Radiology 43 617, 1944) stated that an accurate international unit of measurement had been established He further stated that the Australian government, with a well equipped, well staffed organization was willing to calibrate any x-ray machine in Australia

The purpose of the present article is to point out that the calibrating equipment was not called to the attention of the dermatologists in Australia As no article on the subject appeared in a dermatologic journal, they did not know that this source existed [they might have been informed if dermatologic journals had abstract sections] The authors suggest that physicists should be urged to publish articles in dermatologic magazines dealing with irradiation physics as it concerns the dermatologist

JOSEPH T DANZER, M D

Cytological Analysis of the Response of Malignant Tumours to Irradiation as an Approach to a Biological Basis for Dosage in Radiotherapy P C Koller and D W Smithers *Brit J Radiol* 19 89-100 March 1946

Dosage determination in irradiation depends largely on clinical observation of results. At one extreme are those therapists who from day to day examination of progress determine when to treat and how much to give, at the other are those who try to give as great a dose as the normal tissues can stand in the shortest possible time. What is needed is knowledge that will make it possible to determine the minimum dose that will produce an optimum effect. Scattered information is available on the effect of radiation on isolated biological material but there is little on the effect on a complicated tissue such as a cancer and its surrounding tissues. The present article is a preliminary report on the clinical variation of the response of tumors to irradiation. The study is based on 220 cases of basal cell and squamous-cell cancer of the skin, 196 cases of cancer of the cervix, 42 of the breast, 6 of the lung, and 3 of the esophagus.

An attempt was made by cytological analysis to determine the minimum dose that would produce the optimum response in each tumor examined. One analysis was made of a pre-treatment biopsy specimen and a second at twenty-four to forty-eight hours after the initial dose of radiation, showing the alteration in rate of division, the frequency with which cells showed radiation induced changes in the chromosomal mechanism, and the maximum amount of damage to individual cells as shown by chromosome fragments. These changes are classed as *intracellular* response.

The presence of very few or no dividing cells at the end of the twenty-four to forty-eight hour period suggests that the initial dose was probably too large for that particular tumor and that intervals of more than twenty-four hours between treatments are required. A high number of chromosome fragments is another indication that the dose was too high.

Intercellular reaction consists of inhibition of mitosis in cells adjacent to the tumor cells with resulting de-

generation, infiltration by white blood cells, digestion and removal of degenerated cells, and attempts at the formation of fibrous tissue. This reaction plays an important role in treatment. Many tumors are classed as resistant, despite breakdown of the tumor cells by radiation, because of interference with the *intercellular* response. Timing of the treatment with relation to the *intercellular* response is of equal importance with choice of the correct dose. Treatment at the height of the *intercellular* response damages chiefly the cells responsible for the repair process. If too long a time elapses, cell death may be insufficient to maintain the *intercellular* response or the reparative process may advance too far.

By observation of repeated biopsies an attempt is made to regulate the dose and the rate of fractionation so that mitosis is not completely suppressed at too early a stage and the *intracellular* response is maintained with as small a dose as possible and the *intercellular* reaction interfered with as little as possible.

Studies of superficial accessible tumors indicate that fractionation with appropriate dosage and timing gives better results with lower recurrence rates, than single large doses except in very small lesions. Repeated biopsies were not possible in deep seated tumors, but on the basis of observations on accessible tumors some cases were treated by giving increasing doses at increasing time intervals with encouraging results.

SYDNEY J HAWLEY, M D

Effective Atomic Number and Energy Absorption in Tissues F W Spiers *Brit J Radiol* 19 52-63 February 1946

Measurements of the effective atomic number of excised tissues were made by an absorption method. The results of these studies were used to calculate the linear absorption coefficients and the true energy absorption of the tissues for a wide range of wave lengths. From the results thus obtained approximations were made for conditions of actual treatment indicating that there is a significant difference in energy absorption between fat, muscle, and bone. SYDNEY J HAWLEY, M D

EFFECTS OF RADIATION

The Coagulogram as a Critical Indicator of Irradiation Effect. Preliminary Report Based Upon a Seven Year Survey of the Personnel of the Department of Radiology, Royal Victoria Hospital Joseph Kaufmann *Am J Roentgenol* 55 464-472 April 1946

Because examination of the cytological elements of the blood does not offer a sufficiently sensitive indication of the effects of minimal repeated doses of radiation, the author made a detailed blood study on exposed individuals with particular emphasis on the mechanism of coagulation of the blood. In addition to complete cytological studies the fibrin time, complete coagulation time, prothrombin concentration and blood platelet counts were studied. Studies were made of the professional and technical personnel of the Department of Radiology (Royal Victoria Hospital) including those not exposed to any appreciable radiation. Carefully controlled, repeated examinations were made with particular care to standardize all procedures so as to obtain maximum uniformity.

From the results obtained, it is concluded that the early effect of repeated minimal doses of roentgen or

gamma radiation on the cytologic elements represents an irritative reaction manifested by mild erythrocytosis and moderate leukocytosis. Lengthening of the prothrombin time is considered to be a more critical indicator of minimal radiation damage than is study of the cytologic elements alone. Lengthening of the prothrombin time from a maximum normal of 30 seconds to 45 seconds represents a warning of possible over-exposure. If the prothrombin time is lengthened to 60 seconds or more the individual should be temporarily removed from any exposure and an attempt should be made to neutralize the deficiency. Investigation is in progress to determine whether vitamin K therapy may be a specific for the reduced prothrombin concentration found in connection with irradiation.

H H WRIGHT, M D

Nicotinic Acid in the Treatment of Radiation Sickness Z T Lessa *Rev paulista de med* 26 135-150 March 1945

The author administered a daily dose of 25 to 50 mg of nicotinic acid orally to prevent the development of

'radiation sickness' in 65 patients receiving roentgen therapy for different conditions. He reports that more than three fourths of the patients did not show any general effects of radiation. In a few cases, cutaneous reactions, tenesmus, and diarrhea developed as a consequence of the administration of the drug.

A table giving the age, sex, irradiated region, dose of nicotinic acid, and the results and complications for each case observed accompanies the presentation. No details are given of the dimensions of the field of irradiation nor of the daily dose of radiation administered. This is unfortunate, since the systemic reaction known as "radiation sickness" is in definite relationship with these factors. In fact, an adequate balance of the daily dose of radiation in reference to the size of the field to be

irradiated should eliminate these avoidable untoward effects of the administration of radiations. They should occur but exceptionally in the course of well planned roentgen therapy. J. A. DEL REGATO, M. D.

Medicolegal Aspects of Injuries from Exposure to Roentgen Rays and Radioactive Substances. Charles E. Dunlap. *Occupational Med* 1: 237-301, March 1946.

This is a comprehensive discussion of the medicolegal aspects of injuries from exposure to roentgen rays and radioactive substances. An extensive bibliography is appended, including numerous references to medicolegal cases involving radiation injuries.



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The Carman Lecture

TO COMMEMORATE the life and work of a great man by the establishment of a lectureship bearing his name is in a very special sense to keep his memory green. Not only does it recall from time to time his own accomplishments but it adds to them the luster of kindred achievements by his successors.

The Carman Lectureship of the Radiological Society of North America was founded in 1934 in honor of Russell D. Carman, and in that year the first of this series of distinguished lectures was given at the Twentieth Annual Meeting of the Society by Dr. Carman's successor as head of the Section on Roentgenology of the Mayo Clinic, Dr. B. R. Kirklin. Dr. Kirklin spoke on "The Roentgenologic Diagnosis of Gastric Cancer," a subject to which his predecessor had made substantial contributions.

The following year Dr. Arthur C. Christie, having been named as the second Carman Lecturer, took as his subject "Bronchiectasis: Its Diagnosis and Treatment." He was followed in 1936 by Dr. James T. Case, speaking on "The Field of Roentgenology in the Diagnosis and Treatment of Colonic Disorders," and in 1937 by Dr. George W. Holmes, on "The Development of Post-Graduate Teaching in Radiology." In 1938, another of Dr. Carman's associates at the Mayo Clinic, Dr. W. C. McCarty, Sr., was chosen for this honor.

Like Dr. Kirklin, he chose to speak on "Cancer of the Stomach." Subsequent lecturers and their subjects were Dr. Francis Carter Wood, in 1939, "The Biological Effects of Radiation," Dr. Ross Golden, 1940, "Abnormalities of the Small Intestine in Nutritional Disturbances: Some Observations on Their Physiologic Bases," Dr. W. Edward Chamberlain, 1941, "Fluoroscopes and Fluoroscopy," Dr. Eugene P. Pendergrass, 1942, "Excretory Urography as a Test of Urinary Function."

For the Joint Meeting of the Radiological Society of North America and the American Roentgen Ray Society in 1944, the Carman Lecture, as was fitting, was combined with the Caldwell Lecture of the latter organization, this double honor falling upon Dr. Lawrence Reynolds, who addressed the assembled societies on "The History of the Use of the Roentgen Ray in Warfare."

In 1945 Dr. Robert R. Newell was named Carman Lecturer. As members of the Society will recall, the scientific sessions were cancelled on account of travel restrictions, and it was at first feared that Dr. Newell's lecture would be delivered "by title" only. Happily this was not the case, for the appointment was held over to 1946, and at the largest meeting in the Society's history, Dr. Newell gave the eleventh Carman Lecture, reproduced in full in the ensuing pages.



R. R. NEWELL, M.D.
Carman Lecturer, 1946

Quality of Radiation in Roentgen Therapy¹

Carman Lecture

R R NEWELL, M D

San Francisco, Calif

I FIRST MET Russell Carman when he was President of the Radiological Society of North America and I was just learning my way about in radiology. I shared your admiration for him, those of you who knew him, and shared your depression and sense of loss when he died, only a few years later. There have been ten Carman Lectures, delivered by a selection of the best minds of our Society, who have often expended their best efforts in honoring his memory. Need I say that I feel keenly the honor of joining this illustrious company?

Although Russell Carman's career was in diagnostic radiology, yet I have chosen a therapeutic subject for this lecture.

The invention of 200-kv x-ray machines created such a revolution in therapy that we all became very quality conscious. Dr Chamberlain and I were deeply concerned to choose between 0.5- and 0.75-mm copper filtration—this in spite of our experience in measuring all the deep-therapy outfits in California (1) and finding their 10-cm depth doses all alike (regardless of large differences in output). Later we tried two different qualities on small skin areas, and found that the erythemas from equal doses looked alike (2).

The conviction that the importance of differences in quality is apt to be overestimated and over-emphasized has grown rather than lessened with added clinical experience. I have tried faithfully to choose the quality according to the case, but remain unconvinced of my clinical ability to distinguish the effects of small differences, easily measurable by physical means. I have had opportunity to talk about the biologic and clinical implications of quality before (3). This time I wish to

start with the more practical engineering and physical aspects.

We owe a great debt to the engineers who have built machines to give a range of quality from grenz rays at 10,000 volts through one and two megavolts and on, with the betatron, to 30 megavolts and beyond. Surely, if we can only know what we need, we can have it, just so we can pay for it! I am overcome by admiration for the inventiveness and skill of the men who have driven x-ray production to such heights. And presumably the end is not yet!

We owe a great debt, also, to the physicists who have taught us to measure x-ray precisely and have devised a unit of most peculiar "dimensions" exactly suited to our clinical needs. It may require a 20 per cent increment in dose to be observable clinically, but we can do the physical measurement with an accuracy of 2 per cent. Most of us, in fact, do this as an everyday matter.

The physicists have given us standards of quality, too. We have the international agreement to designate quality by half-value layer (h_{v1}), naming a suitable absorber. Now this is a very delicate method, capable of detecting a change of a few kilovolts on the tube or a few per cent increase in filtration. I am not sure that this was so great a service. It resulted in a senseless striving for slightly harder qualities and a competition among apparatus makers that did our profession no good. Do you remember the violent controversy constant potential *vs* pulsating rectified? It seemed axiomatic to us then that, since one so easily measured the difference (h_{v1} 's 1.2 and 0.9 mm of Cu), it must

¹ Delivered at the Thirty-Second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec 3, 1946.

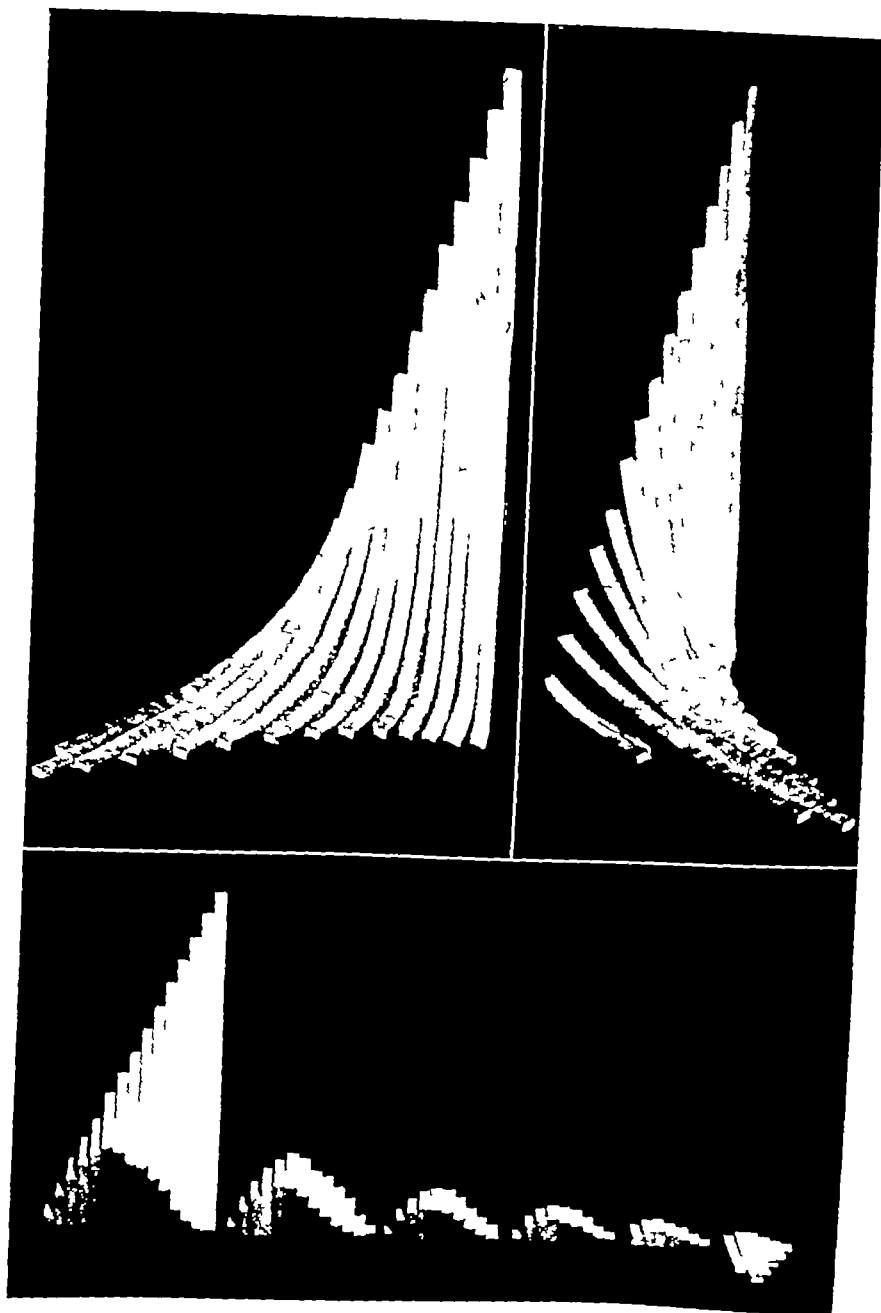


Fig 1 Model to show the effect of filtration on a heterogeneous beam of x ray (photo-electric absorption neglecting scattering) One is looking at the model from the back. The face is a plane triangle corresponding to the graph on the frequency scale of Fig 2. In the lower photograph saw cuts separate the portions absorbed by successive layers of filter. Note how the huge mass of low frequency (long wave length) radiation is removed by the first filter. After this further filtration reduces the quantity and shifts the maximum only slowly to the left (harder qualities).

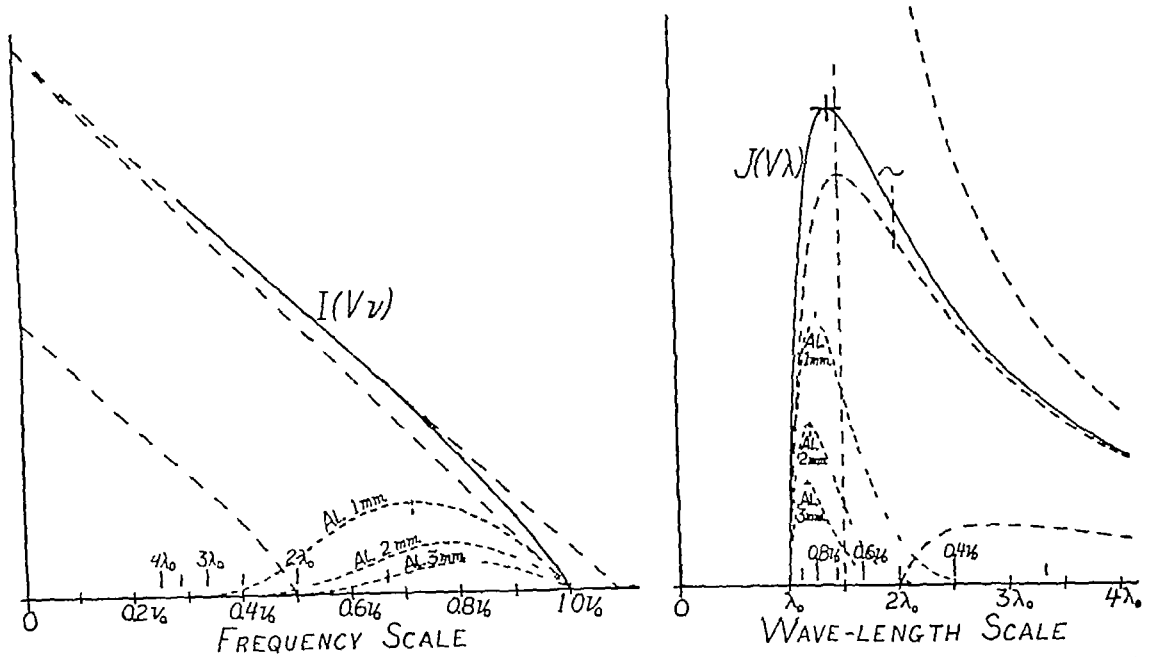


Fig 2 Spectrum of the heterogeneous beam of ν ray coming from a thick target (From Webster and Hennings)

therefore be important. I am not sure but that one of the most useful by-products of "supervoltage" may be the laying of this ghost. When one finds so little clinical difference between h.v.l.'s 1 mm and 5 mm of Cu, one really can no longer break one's heart over a fraction of a millimeter. But the ghost has life in him still! The competition is picking up, and we are "sold" on the superiority of 250 kv over 200.

Quality is obtained by voltage and filtration. High voltage costs much money, heavy filtration costs much ν -ray. This is to say to make ν -ray hard by filtration, you have to throw a large amount of the beam away. Of course, you can't put in what wasn't there to start with, you can only remove the softest components. Figure 1 shows a three-dimensional model illustrating the effect of filtration on a beam of heterogeneous ν -rays. This is based on an observation by Webster (4) that, plotting quantity against frequency, one gets nearly a straight line (Fig 2). The quantity in a low-frequency sample is large, and diminishes with increasing frequency until it is zero at the high-frequency limit (minimum wave length).

Now each of these samples is absorbed as

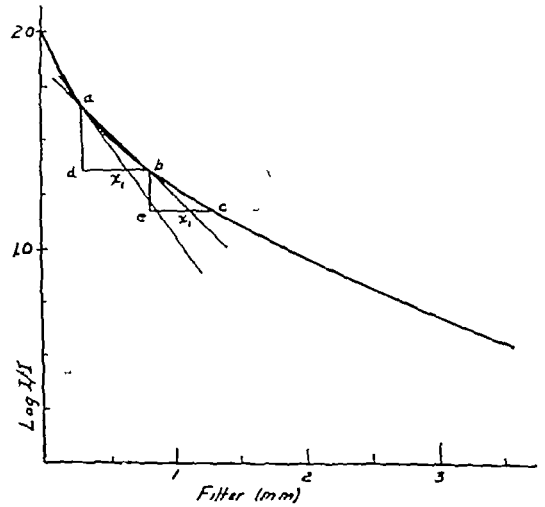


Fig 3 True effective wave length vs Duane's effective wave length. On the complete absorption curve, *a* marks the exit from the working filter, *b* marks the transmission through added 0.25 mm Cu. The slope of the secant *ab* gives the effective wave length according to Duane. The tangent at *a* gives the "true" effective wave length without the error produced by hardening within the test filter. (From Taylor)

it goes through the filter, the low frequencies more than the high frequencies. The (photoelectric) absorption of each frequency sample (monochromatic) is logarithmic. The half-value layer increases with the cube of the frequency. The front view of the model (Fig 1) shows the frequency

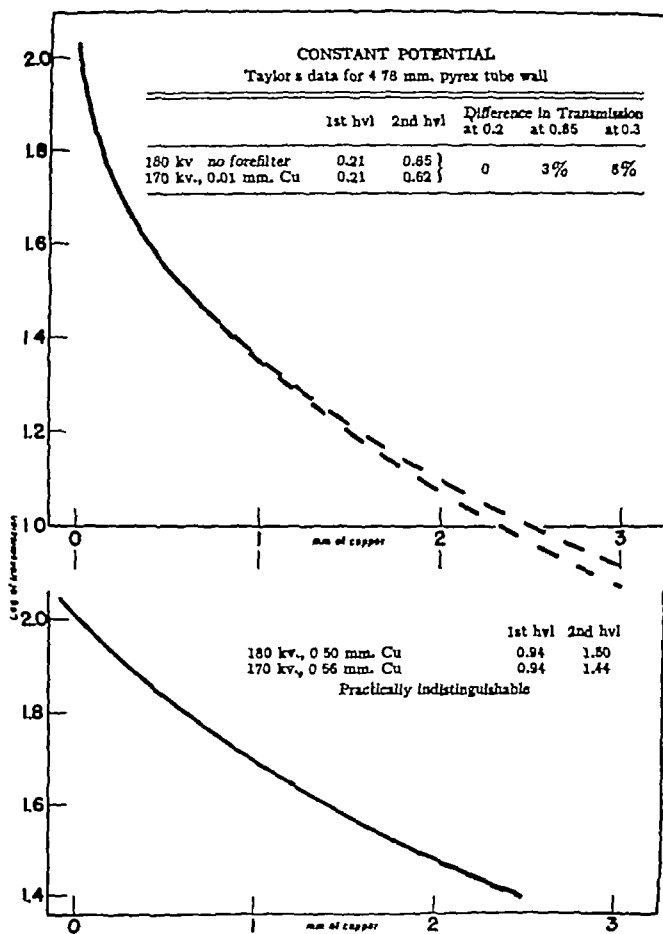


Fig 4 Two x ray beams having the same hvl may yet be different as shown by carrying the absorption curve out farther (upper curves) This discrepancy appears less for heavier fore-filters (lower curves)

samples The side view shows the absorption curves, different of course for each sample The four lowest frequencies are so absorbable, drop to almost nothing so quickly, that they have been left off

Cutting the model across at various thicknesses of filter shows how great a hardening comes from the first layer and how slowly the hardening proceeds after that and how small a quantity remains after really heavy filtration One has so little of the very high frequencies to start out with Considering the hardest portion, one would do well to increase the voltage 10 per cent and so double the original quantity of the top 10 per cent sample (now the next to the top)

SPECIFICATION OF QUALITY

In the earliest days of x-ray, quality was designated by the "parallel spark gap" (between points) When we began to filter our x-ray beams, of course we had to say what filter The engineers then told us we ought to use sphere gap Fortunately this was always calibrated in kilovolts, so one always knew that a published spark-gap (inches or centimeters) meant points I don't see that point gap is such a poor measure, but the matter is academic now, for modern machines are all enclosed, with no place to connect a spark gap One has to accept the factory calibration

Then there was a great furor about spectrographic determination of the short wave

TABLE I DIFFERENCES IN LOG TRANSMISSION THROUGH SUCCESSIVE HALF MILLIMETER COPPER FILTERS (Smoothed Values from Data of Taylor and Singer for Constant Potential)

Filter 5 mm Pyrex plus mm Copper	Kilovolts Constant Potential								
	100	110	120	130	140	150	160	170	180
0 to 0.5	0.786	0.722	0.667	0.620	0.580	0.547	0.520	0.499	0.484
0.5 to 1.0	0.312	0.278	0.252	0.231	0.216	0.205	0.194	0.182	0.175
1.0 to 1.5	0.257	0.225	0.203	0.184	0.171	0.160	0.150	0.143	0.138
1.5 to 2.0	0.224	0.194	0.174	0.157	0.145	0.135	0.126	0.120	0.116

EXAMPLE OF CURVE-FITTING BY COMPARISON OF DIFFERENCES IN LOG TRANSMISSION (200 Kv, Mechanically Rectified 5 mm Pyrex Tube)

Filter, mm Cu	r/min	log r/min	Differences	Taylor's 160 kv from Table Above
0	283	2.452		
0.5	97	1.987	0.465	0.520
1.0	62	1.792	0.195	0.194
1.5	46	1.660	0.132	0.150
2.0	34	1.533	0.127	0.126

limit (5) Because the end of the spectrum contains little x-ray (especially on pulsating potential) the spectroscopist always measured the voltage 5 or 10 per cent below what the spark gap indicated. This was supposed to be very bad—that one claimed he was using 200 kv and the spectrum only went to 180 kv. This was hardly short of cheating! But nobody dared to insist that we ought to determine our quality by photometry of the spectrum. It is true that the spectrum does give the ultimate analysis of composition of an x-ray beam, but so many corrections have to be applied that it's completely impractical. We did all agree that absorption measurements are the way to determine quality.

It was pretty obvious that to designate quality by a complete absorption curve was much too cumbersome, although Ernst did on one occasion make just that suggestion (6). What was needed was a simple numerical designation of quality. Long before the International Committee plumped for h v 1, Duane (7) had advanced the "effective wave length." This he designated as the wave length of monochromatic x-ray which would show the same absorption in copper as the x-ray beam in question. Since clinical x-ray beams are



Fig 5 Spectrogram of x-ray beam at 85 kv, filtered through 0.65 mm Cu (right half) vs 0.22 mm Sn (left half), showing the large amount of x ray coming through the tin at wave lengths just longer than the K absorption edge. This was made with diamond, because this crystal gives no reflection (diffraction) in the second order. Otherwise, the second order of the tungsten characteristic would have overlapped the tin discontinuity.

not monochromatic, the match could only be over a certain range, and Duane chose 0.25 mm Cu. This was really an excellent convention, and deserved to be perpetuated. It gave in a single number a quite adequate measure of quality for clinical purposes.

But some people are never satisfied. I recollect with shame how I complained that 170 kv constant potential and 200 kv pulsating rectified, filtered to give the same effective wave length, could not in fact be

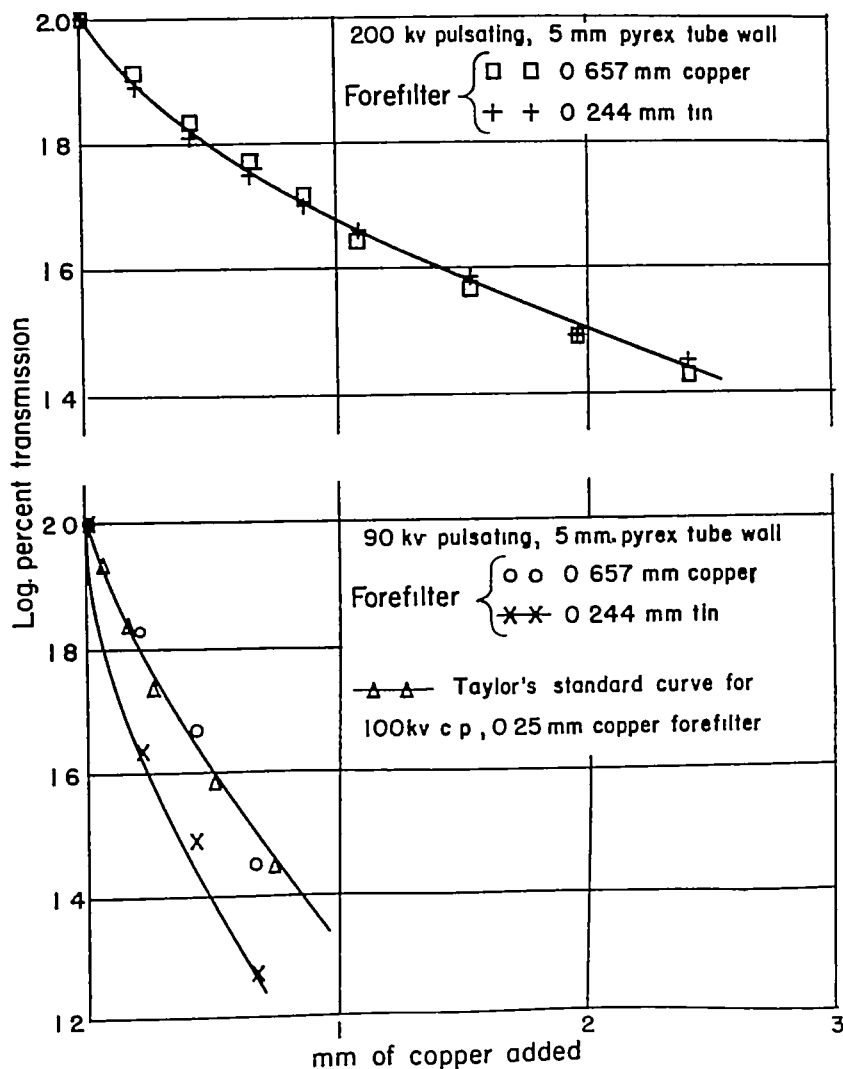


Fig 6 Absorption curves for tin filtered and copper filtered x-ray beams are similar at high voltages (upper curve) but cannot be brought to match at lower voltages (lower curves). Note that the first 0.2-mm Cu added filter "closes the window" in the tin forefilter. This "window" of anomalous transmission had evidently been augmenting the beam by about 60 per cent.

the same in composition. True, but so unimportant! And then the purists pointed out that the beam was really softer than indicated by Duane's "effective wave length" because he had hardened it in measuring it (by the 0.25-mm Cu filter). What one should do was to draw the whole absorption curve and take the tangent through the initial point (S), not (as Duane did) the secant through this point and the 0.25 mm Cu point (Fig 3). This controversy was starved out, of course,

after the international acceptance of h v l for the designation of quality.

Then Lauriston Taylor took over the x-ray standardization work at the National Bureau of Standards and ran the most precise absorption curves on clinical qualities of x-ray that we have (9). Some of his observations should have made things simpler for us, e.g., that the absorption curves are all of pretty much the same general shape and that constant potential is nearly like pulsating potential of the same

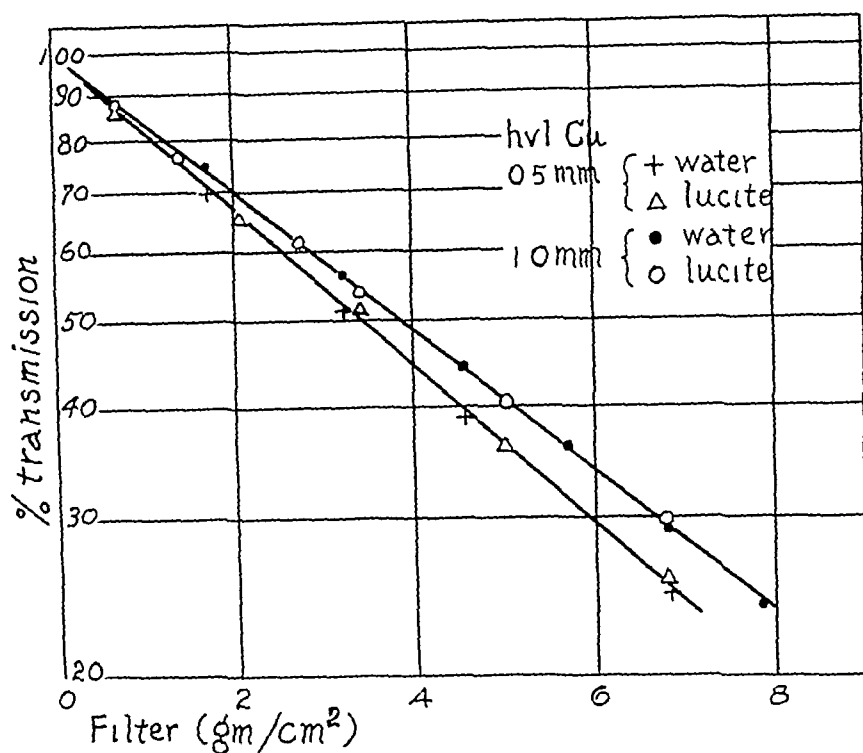


Fig 7 Absorption curves in water and in lucite for 200 kv x ray beams filtered to give copper h v l's 1.0 and 0.5 mm. Note that the filters are measured in gm/cm², so as to avoid the discrepancy in their densities

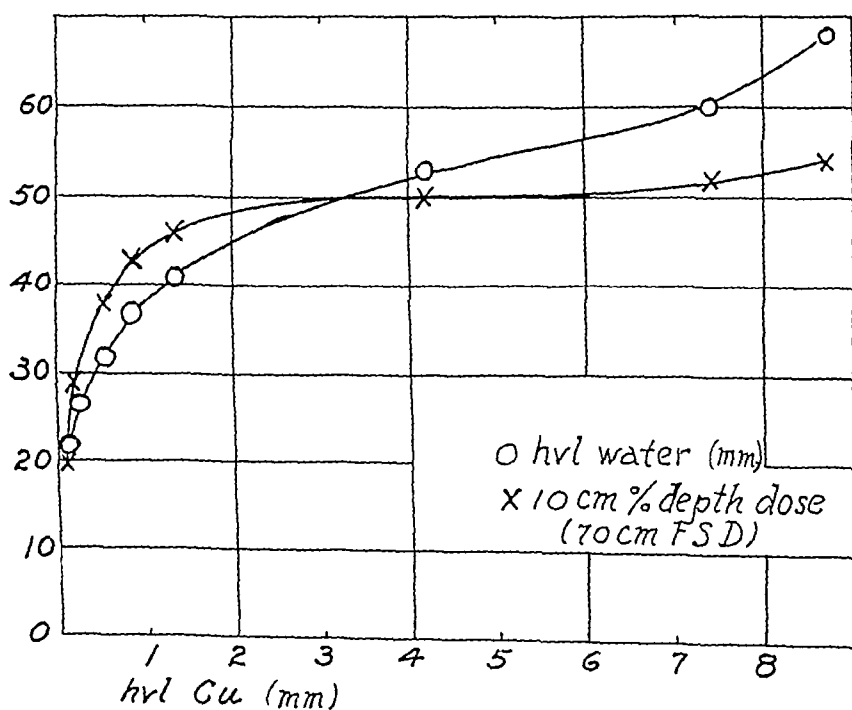


Fig 8 Relation of the h v l in water and the 10 cm percentage depth dose to the quality of x ray as measured by h v l in copper (Ehner's data)

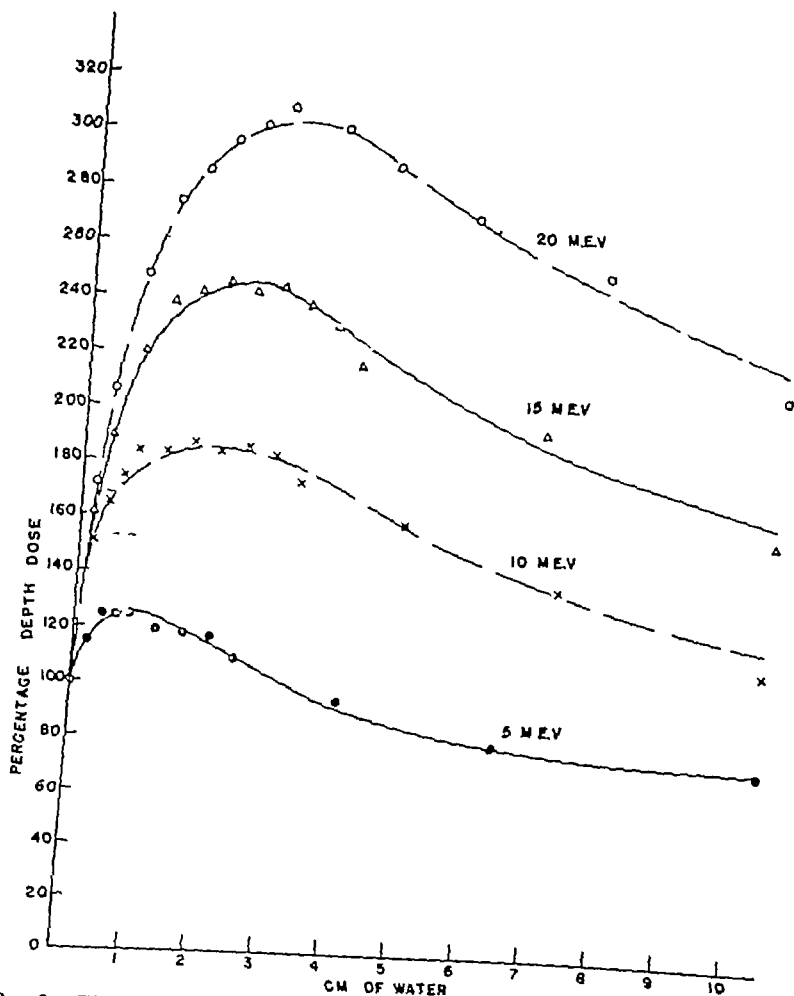


Fig 9 The percentage depth doses and exit doses from betatron beams are enormous (From Koch, Kerst and Morrison)

rms value (10) Being a perfectionist, he wanted us to match our clinical curves to one of his c p ones and call our quality by naming his voltage and filter I was quite taken in by this, being too much inclined to bootless perfectionism myself I observed that one could make the match by figures, comparing logarithmic differences, and so get it down to the third significant figure

We are impressed by the shortcomings of the internationally accepted h v l, for two beams could have the same first half-value layer and yet be so different in heterogeneity that the lower parts of their curves would deviate So some of us talked about naming first and second h v l's Enner

(11) called the ratio of 2nd h v l to 1st h v l the homogeneity coefficient (Fig 4)

Later I was able to produce two beams, one filtered through copper and the other through tin, so different in composition, on account of the absorption discontinuity in tin at 0.4 \AA (Fig 5), that none of Taylor's standard curves would match it (Fig 6) So Taylor's "perfect" method was not completely general after all

If we had not still been suffering from the superstition that small differences in physical quality were of importance to the patient, we would have seen that naming the rms voltage and the filter is quite precise enough

A number of workers had called atten-

tion to the "window" in any filter due to the absorption discontinuity (illustrated in Fig 5), pointing out that a lead filter must be backed by tin and a tin filter by copper (12) It seemed that perhaps the Standards Committee ought to designate certain standard qualities which could then be referred to by letter or number (Table II)

TABLE II

Symbol	kV	Filter
A	12	0
B	50	0
C	50	1 mm Al
D	50	0.3 mm Cu
E	100	0
F	100	1 mm Al
G	140	0.25 mm Cu + 1 Al
H	200	0.5 mm Cu + 1 Al
I	200	0.4 mm Sn + 0.5 Cu + 1 Al
J	400	1 mm Sn + 0.5 Cu + 1 Al
K	1,000	1 mm Pb + 0.5 Sn + 0.5 Cu + 1 Al

I suspected that this would never be accepted, doctors would never yield to such dictation But I was still playing with the idea of quality designations by a single name I was distressed by published case reports, reading, for example, "pulsating potential, 196 kVp, 5-mm pyrex tube wall, plus 0.5 mm Cu, plus 1 mm Al, h v l 0.99 mm Cu "

Now hard qualities are absorbed in light elements mostly by the scattering mechanism, which changes little with wave length So it was already well accepted that the harder the quality, the higher the atomic number needed in the filter for measuring its h v l By adding one filter material to the list customarily accepted, it would be possible to cover the whole clinical range, with a unique name for each quality (Table III) I think it was U V Portmann who made me see how impossible it would be to get doctors to agree to such a strait-jacket as this

However, it would indeed be advantageous if we could designate quality by a single number To do this, we have to agree on a single test filter substance It should be so light that its K absorption edge will be quite out of the way, otherwise the values will not run upward smoothly.



Fig 10 Epilation produced by 600 r h v l 0.3 mm Al With this quality the usual 300 r is entirely inadequate

TABLE III

h v l	Designation
5 mm celluloid	Plastic
1 mm Al	Alumic
1 mm Fe	Ferric
1 mm Cu	Cupric
1 mm Sn	Stannic
1 mm Pb	Plumbic

Water comes first to mind, particularly because it is absorption in water that dominates the clinical use of radiation More than one friend has asked, pointedly enough, why our physicist gives him h v l in copper, when it's not copper he's irradiating, Figure 7 shows logarithmic absorption curves in water for two common qualities of x-ray They seem to show no curvature Mayneord (13) has measured some hardening in the supervoltage region just by water, but it hardly shows on absorption curves Of course, filtration can't harden the ray very much, when

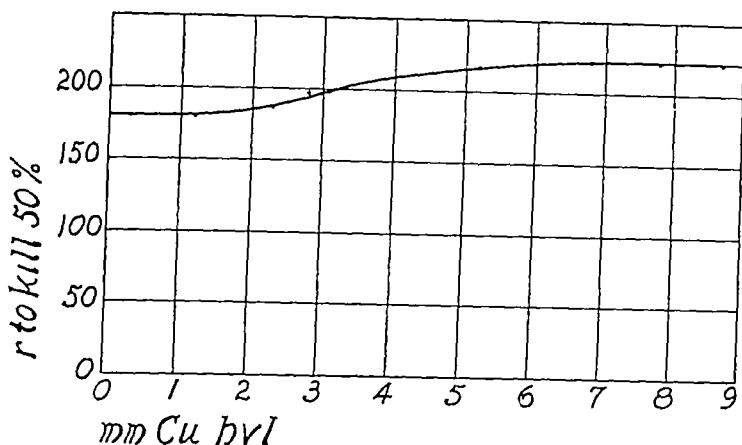


Fig 11 Quality dependence of biologic effect of x rays The 50 per cent lethal dose for *Drosophila* eggs changes by about 20 per cent over a quality change 1 mm to 6 mm $h\ v l$ Cu (Packard's data)

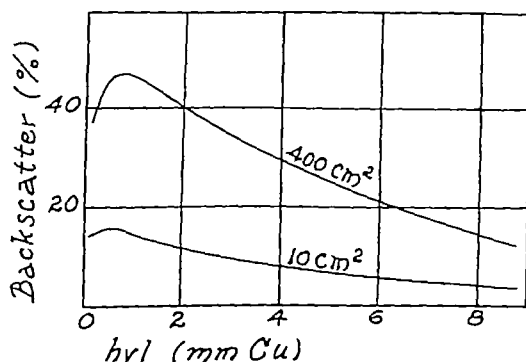


Fig 12 Dependence of back-scattering on quality and area (From E \ddot{u} ner and Packard)

there's so little difference in the absorption of the soft and hard portions of the beam. Note the small difference in slope of the two qualities illustrated in Figure 7. Their $h\ v l$'s in water differ by only 10 per cent, but that's similar to the percentage difference in their penetration as used clinically.

Figure 8 is adapted from E \ddot{u} ner's data (11). It plots $h\ v l$ in water along with 10 cm percentage depth dose over a long range of qualities. Note that for softer qualities depth dose changes faster than $h\ v l$ in water, and for hardest qualities *vice versa*. But, taken all in all, the two run pretty much together.

Let us take two qualities, $h\ v l$ in water 40 mm and 50 mm, respectively. Seeing the ratio, $50/40 = 1.25$, one might jump to the conclusion that the second is 20 per cent

better than the first for reaching deep-seated cancer. This would surely be nearer to the truth than if one had compared their $h\ v l$'s in copper, namely 1.25 and 4.5, and concluded that the latter should be about three and a half times as good as the former.

Now measurements in water are, in fact, inconvenient. It would be easier if we had a similar absorber in solid sheets. Lucite seems convenient for this, but is slightly denser than water ($d=1.13$) and to make it match must be measured not in centimeters, but in gm per sq cm (Fig 7).

I have had no opportunity to try this scheme at 2 megavolts, nor at 30 megavolts. Those who use the betatron for therapy have a difficult problem of measurement before them, for depth dose is built up by the accumulation of recoil electrons along the beam (14). One could measure the extinction coefficient in water (or lucite) by removing the recoil electrons with a magnet before they get to the ionization chamber, but I doubt whether the data would be clinically worth having. Anyone reporting on treatments with a betatron will have to measure and report the very large depth doses in a phantom, and the large ext doses (Fig 9). Small differences in quality are unimportant here, too, and the estimated megavolts will be precise enough.

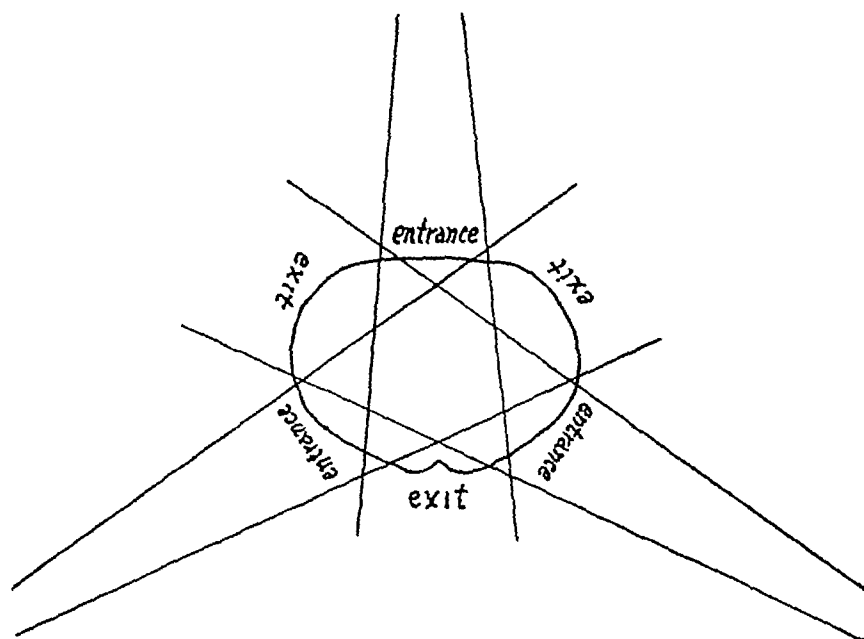


Fig 13 Irradiation of pelvis through three equidistant ports, to avoid superimposition of exit doses

COMPARATIVE INFLUENCE OF EXIT SKIN DOSE USING HIGH AND SUPER VOLTAGE

CASE OF THICK SECTION 24 CM.

10X10 FIELDS

20X20 FIELDS

SINGLE-FIRE

CROSS-FIRE

SINGLE-FIRE

CROSS-FIRE

200 KV

100	27.5	3.2	103.2	55	103.2	100	37	5.5	105.5	74	105.5
			100	53.3	100				100	70.2	100

1000 KV

100	41	11	111	82	111	100	48	15	95	96	115
			100	73.9	100				100	83.6	100

RATIO $\frac{1000 \text{ KV}}{200 \text{ KV}}$

$\frac{41}{27.5} = 1.49$
Ratio

$\frac{73.9}{53.3} = 1.39$
Ratio

$\frac{48}{37} = 1.30$
Ratio

$\frac{83.6}{70.2} = 1.19$
Ratio

Fig 14 In direct cross fire technic going to harder qualities the augmented exit dose may easily undo all the advantage one had hoped to gain by the diminished back scattering. Although the cross fire depth dose with large fields is 74 per 100 applied for 200 kv, and 96 per 100 applied for 1 000 kv, yet the exit dose has amounted to so much more for the latter that the comparative ratios of depth to total skin dose are 83 for 1,000 kv against 70 for 200 kv, only a modest improvement (From Stone and Aebersold)

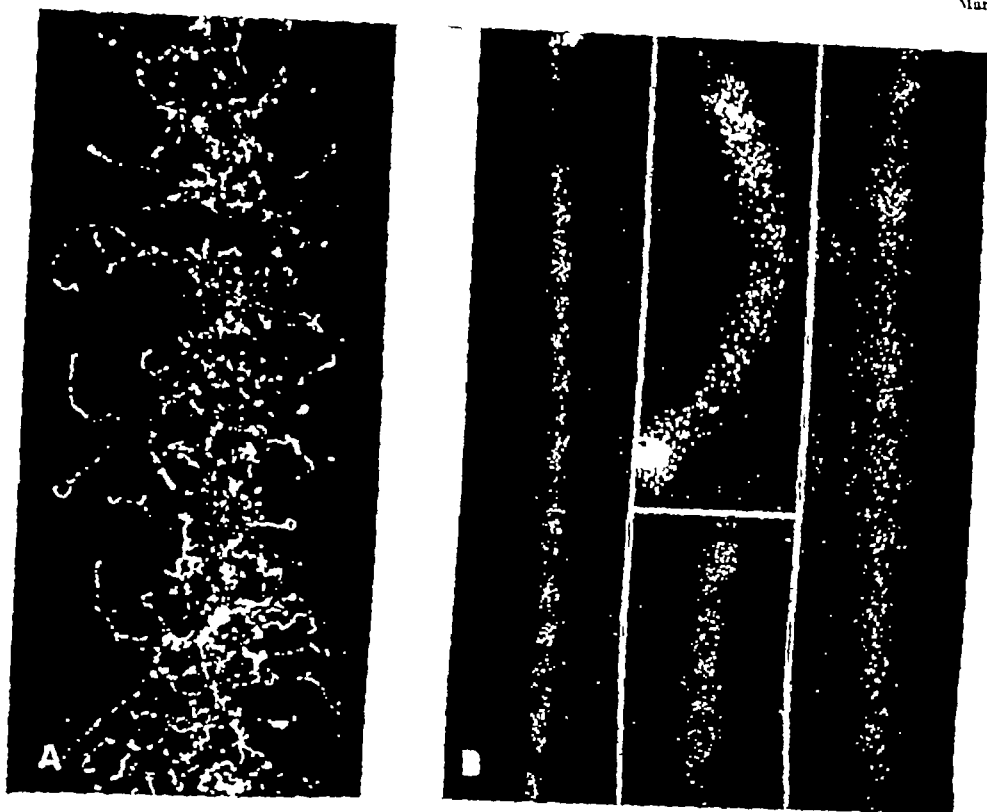


Fig 15 A. In the Wilson cloud chamber water droplets condense on the ions produced by photo-electrons from a narrow beam of x rays (low voltage) (From Wilson) B Ionization (clusters) (From Corson and Brode Phys Rev 53 773-777, 1938)

In the megavolt region, nuclear absorption becomes important, increasing with frequency, also with atomic number. This may, at high enough voltages, result in a paradox, namely that filtration may soften the beam (in the sense of absorbing out the short wave lengths more than the long ones).

I would like now to reiterate my conviction, expressed in past years, that more attention has been paid to quality than it deserves. In some ranges quality is important. Using h v 1 or 2 mm Al, epilation of the scalp is ordinarily done with 300 r to each of five areas. Using a "contact therapy" machine with h v 1.03 mm Al, 600 r is barely sufficient (Fig 10). Packard (15) was long skeptical of any difference in biologic action between one quality and another. But he was able to show a quality dependence for *Drosophila* eggs (16) when the dose is measured by the Vic-

toreen "air wall" chamber (Fig 11). Stone (17) showed that 23 per cent more x-ray (measured as tissue dose in the skin) was needed at 1,000 kv than at 200 kv, but that when this quantitative adjustment had been made, then the reactions came up alike, looked alike, and recovered alike. I have not reproduced his photographs, for they are in color. The reader ought to review his essay, for it reports one of the neatest clinical experiments ever done in this field.

Reference should be made to Lauritsen's (18) calculations showing that the specific energy absorption per roentgen in the surface layer should be different for different wave lengths. Many workers have reported the dependence of "erythema dose" on quality. They are not all in quantitative agreement, and many are at variance with my clinical impressions.

Precisely measured and well tabulated,

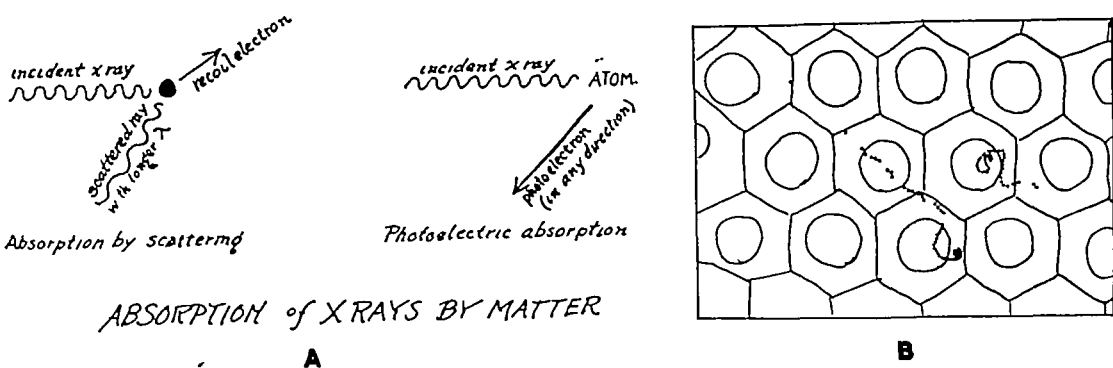


Fig 16 A Idealization of the two mechanisms of absorption of x ray energy namely photo-electric and Compton scattering The product is a high speed electron B The high speed electron leaves a track of ionization as it passes through the cells

however, are the gross differences in penetration and back-scattering (Figs 8 and 12) Those of us who measure our doses "in air" use such tables, *e g*, Quimby's (19), every day to calculate the "skin dose" and the "tumor dose" The careful worker will choose a technic and a quality adapted

accurately A precision of 15 or 20 per cent is about the limit Moreover, the sensitivity of the same tissue (skin) varies markedly from one location to another in the same patient And one continually runs across individuals of unusual radio-resistance or unusual radiosensitivity

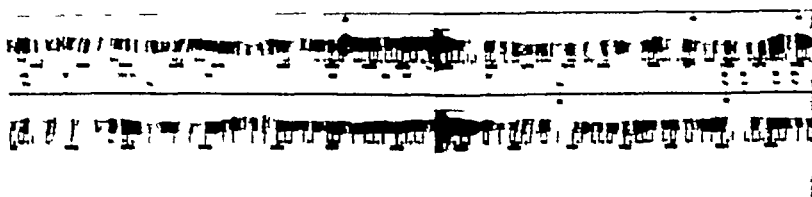


Fig 17 Giant chromosomes from the salivary gland of an insect (*Drosophila*) Presumably the cross banding marks the locations of the genes which in the normal size chromosomes of the ordinary somatic and sex cells exist as single bio-molecules Irradiation can destroy a single one of these genes, leaving the rest intact (point effect) (From J Heredity 26 62 1935)

to that technic which will get a desired quantity of radiation into the part of the patient where it is wanted Multiple fields with exit doses avoiding the input areas are an example, using the harder qualities (Fig 13) In this, one escapes the difficulty pointed out by Stone (20), that cross-fire technic on the pelvis gives little better central dose with 1,000 kv than with 200 kv, except in large patients (Fig 14)

I realize that my arguments have been physical and theoretical I don't wish you to think that I'm ignoring clinical experience That in the end must be the critical test But clinical results are hard to read

In treating cancer we are forever driving the dose up to the limit from which the normal tissue can recover If complete destruction of skin epithelium can be attained by a course totaling 5,000 r at h v 1 1 mm Cu, it is my experience that this dose doesn't have to be altered more than about 20 per cent when using other qualities between h v 1 0 3 mm Al and 6 mm Cu

THE FUNDAMENTAL PHYSICAL ASPECT OF QUALITY

The physical process of absorption of x-ray produces high-speed electrons and these produce ions I can see nothing

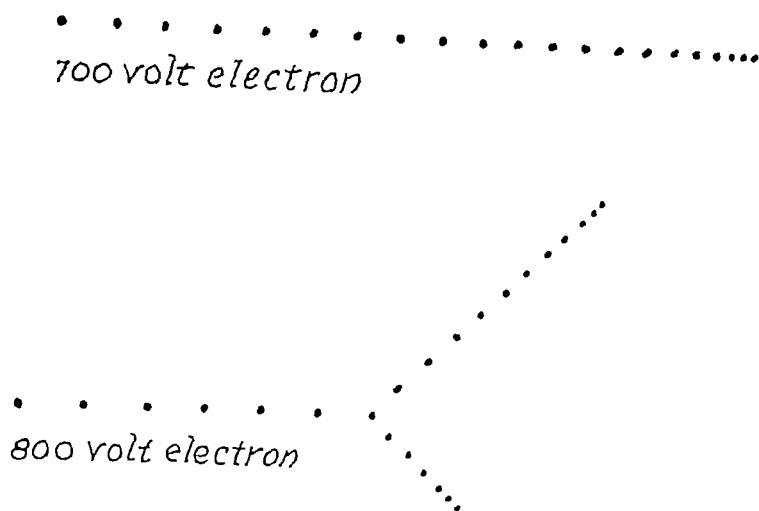


Fig 18 Diagram of the increasing columnar density (specific ionization) as the high speed electron slows down toward the end of its path. Branched tracks are not infrequent so that clusters of ions account for half to two-thirds of the total. For simplicity the crooked track has been drawn straight and the inequalities of probability smoothed out.

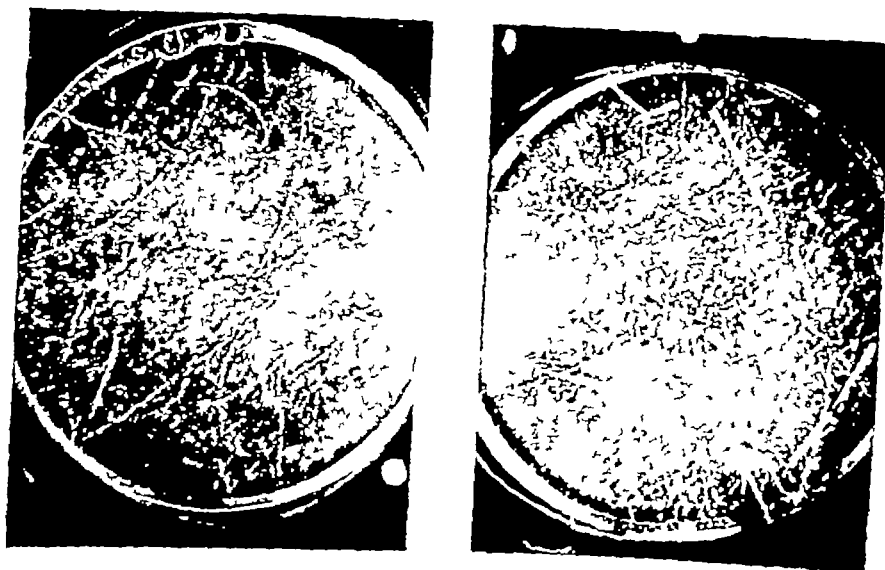


Fig 19 Contrast between the relatively sparse ionization along the tracks of high speed electrons (from gamma rays) and the very dense ionization along the tracks of high speed protons (from fast neutron rays). Cloud chamber photographs by courtesy of Dr E O Lawrence. Left hand photograph gamma rays produce recoil electrons whose paths are curved in the magnetic field. Right-hand photograph neutron rays produce recoil protons whose paths are nearly straight and very densely ionized.

available in this for any biologic specificity. The cloud tracks of Wilson and of Brode, in Figure 15, show what I'm talking about. The sketches show how I imagine the tracks of ionization go in tissues (Fig 16). You are acquainted with the genetic evidence proving that α -rays can affect one

tiny part of the cell (one gene) (Fig 17). The collisions that produce the ions make the electron tracks crooked (Fig 15). In order to see better what is going on, let us pretend that they are straight. Figure 18 shows how the ions get thicker and thicker toward the end of the path. In this region

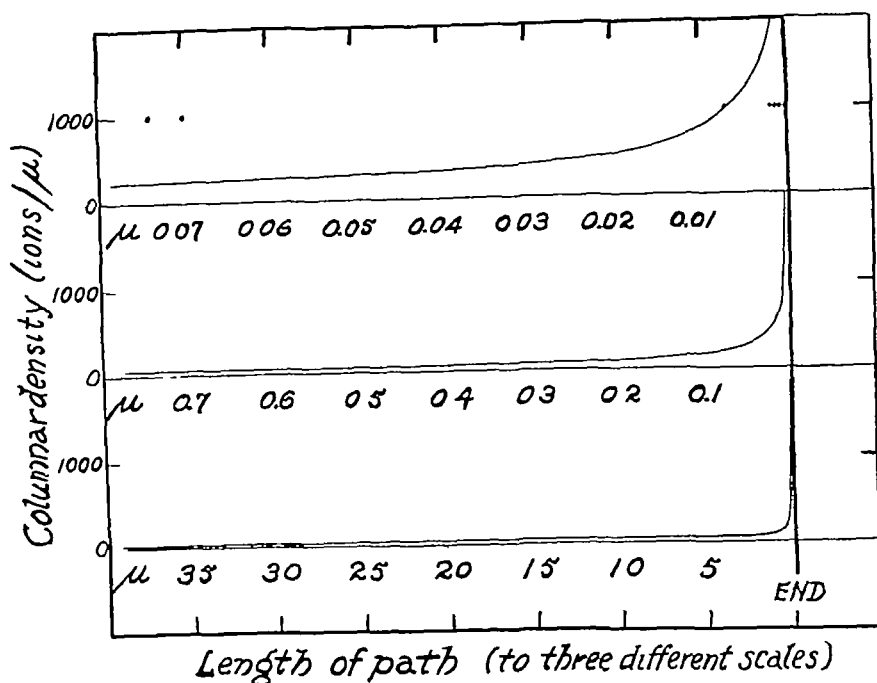


Fig 20 Specific ionization (columnar density of ionization) along an electron track. At the top is shown how the ions get thicker as the electron slows down. Superimposed is a plot of this picture. In order to show a greater length of the track, the scale has been compressed by a factor of 10 for the third line. This still shows only the terminal 0.7 micron of the track, so in the last line the scale has been compressed by another factor of 50. Branching (clusters) has been ignored.

the probability of ionization increases as the inverse square of the speed of the electron (inversely as the energy). Not all tracks are single, a collision may give so much energy to the electron struck that it will go off on an ionizing path of its own. Clusters due to such branching may account for two-thirds of the total ions (21).

Now it is known that biologic effect is correlated with this columnar density of ionization. Neutron rays give recoil protons (Fig 19), and the ionization along these paths is more like that of alpha rays—a hundred times as dense as along an electron's path. And we know that ion for ion, neutron rays have two to ten times the effect of x-rays on living tissues (22).

So maybe here is the physical basis for a biologic dependence on quality. Mayneord (23) has calculated that over the whole range of clinical irradiation, 10 kv to 2,000 kv, the average length of path (ionization track) might vary by a factor as large as six. Now this is small, when in comparing

x-rays and neutron rays we realize that a factor of one hundred is needed in columnar density of ionization to give a biologic factor of about five.

Nevertheless, let us look at the columnar densities produced by various x-ray qualities. These are plotted in Figures 20 and 21, but remember they are not simple like this, but always very much mixed, for scattering occurs at all angles and so in every quality the scattering produces a great variety of energies in the resulting recoil electrons. Moreover, these plots ignore the frequent clusters due to branching.

The thing in this picture that impresses me most is that every electron, high-speed or low-speed, ends up the same way, in a densely ionized spot. Maybe we ought to give these credit for most of the biologic effect. Maybe what is important is the number of photo- and recoil electrons produced (per cubic micron). Maybe the ions of lesser columnar density along the high-speed portions of the tracks are very inefficient. Maybe, when we go to a mil-

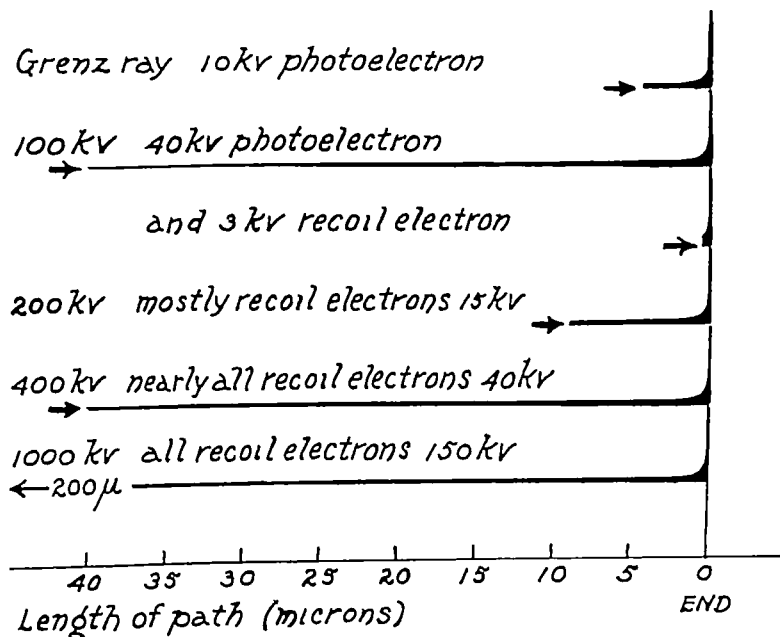


Fig 21 Rough designation of specific ionization by plotting the track of a typical high speed electron produced at each of the several clinical qualities of x ray. The important thing to see is that all qualities give electrons and that all of these, high speed or low speed end up the same way in a spot of dense ionization. It is presumably this spot that holds most of the biologic effectiveness.

lion volts, we merely add on a lot of long, sparsely ionized high-speed preliminaries that practically waste their ions. Maybe this accounts for the need to add 25 per cent to the dose (total volume ionization) to make the effect of 1,000 kv match that of 200 kv. You will note that this latter quality just about attains a minimum average length of ionization track and so a maximum number of ions (dose) given total number of ions (dose).

But I still don't see very clearly how one quality is going to be better able than another to ferret out the cancer cell.

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A Duodenal Mechanism Regulating the Motor and Secretory Activity of the Stomach

Its Roentgenographic Disturbance in Duodenal Ulcer¹

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A major roentgenologic problem arises from the difficulties encountered in interpreting abnormal motor and secretory disturbances in a large percentage of persons suspected of having a duodenal ulcer (2, 11). These abnormal motor changes are disturbances of gastric tone, peristalsis,

person with a normal gastro-intestinal tract, a 250-c c water-barium meal usually is emptied from the stomach in sixty minutes. If this procedure is repeated with a 250-c c 0.25 per cent hydrochloric acid-barium meal, gastric emptying is delayed. If a similar concentration of hy-

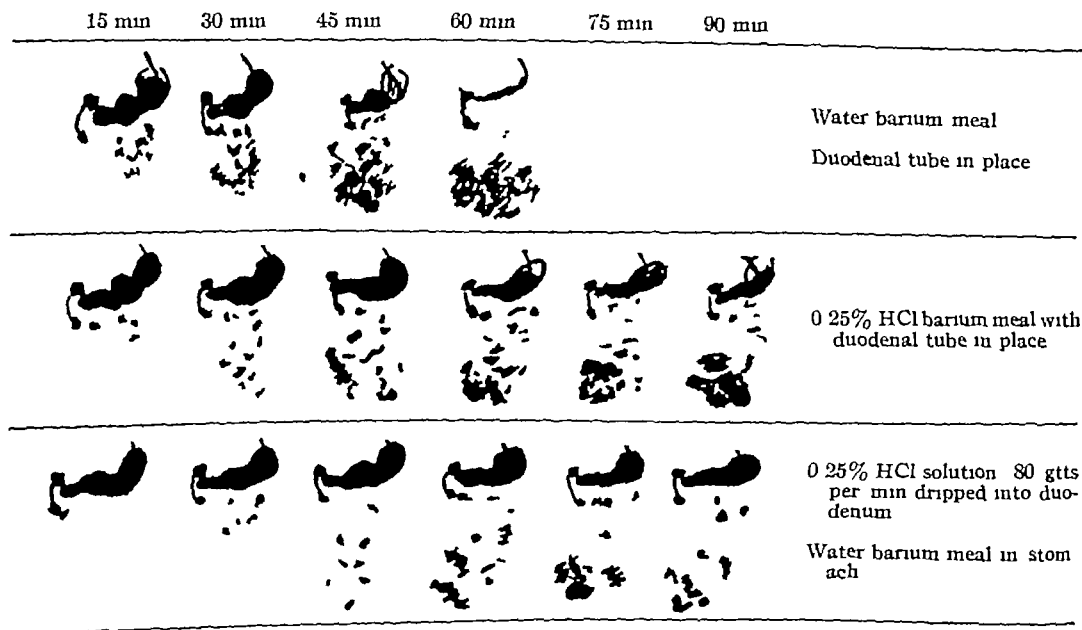


Fig 1 Gastric emptying is more retarded by acid on the duodenal than on the gastric side of the pylorus

and action of the pylorus, which is an important regulator of gastric emptying. The mechanism regulating all these activities seems to be housed in the duodenum, to be referred to here as the "duodenal mechanism" (8, 9).

THE DUODENAL MECHANISM

In looking for the factors which control gastric emptying, it was found that in a

drochloric acid is dripped directly into the duodenum, a more marked delay occurs. Acid on the duodenal side of the pylorus thus seems to have a greater effect on the retardation of gastric emptying than does acid on the gastric side (Fig 1).

While this applies to all subjects, there are quantitative differences due to variations of gastric acid secretion among different individuals and, sometimes, in

¹ Read by title at the Thirty first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov 9-10 1945

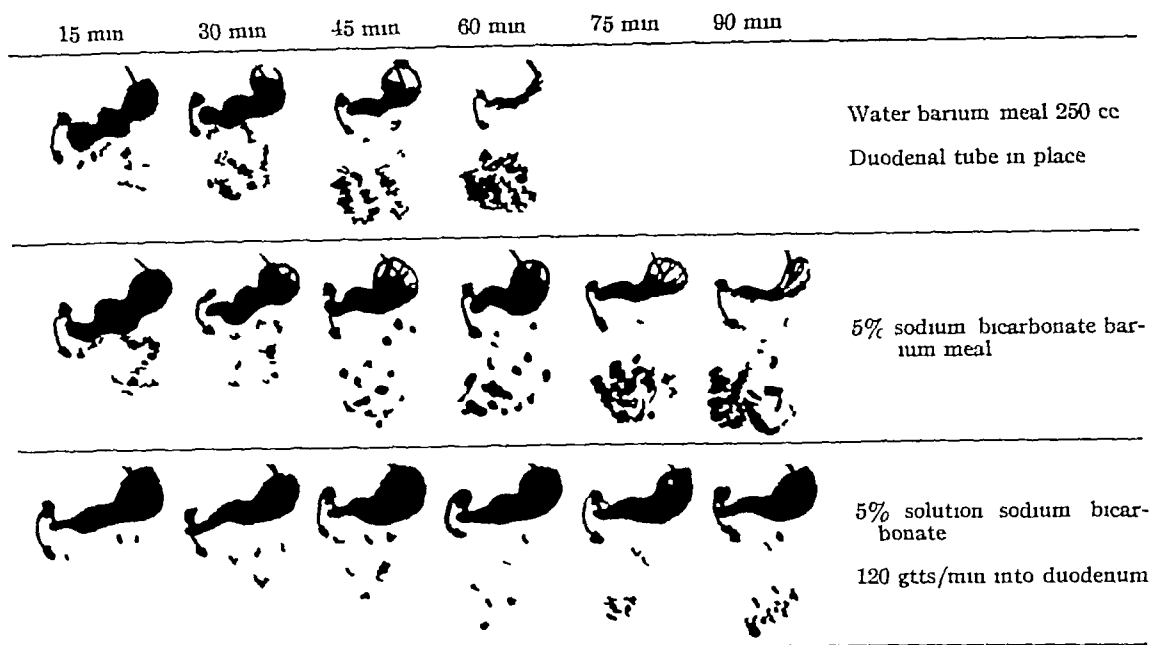


Fig 2 Gastric emptying is more retarded by hypertonic alkaline solutions on the duodenal than on the gastric side of the pylorus

the same individual. Thus, if a weaker acid concentration, such as 0.1 per cent hydrochloric acid solution, is dripped into the duodenum, the slowing of gastric evacuation is greater in an achlorhydric individual than in one with normal gastric secretion.

With stronger acid solutions, such as 0.5 per cent hydrochloric acid, not only is stimulation of the duodenal mechanism more intense, but also there is a greater uniformity of response regardless of the intrinsic variation in gastric secretions among different subjects (8). Under these conditions, gastric emptying is always inhibited, with closure of the pylorus and cessation of peristalsis.

When alkaline solutions were tested, it was found that they also exerted a greater effect on the duodenal side of the pylorus. When an isotonic alkaline solution is used, such as 1 per cent sodium bicarbonate, there is little effect on the duodenal mechanism, and the variation in the response to stimulation depends on the gastric acid secretion characteristic of the individual. In an average person with normal gastric acid secretion, gastric evacuation is

hastened. This might be explained by the fact that each trial portion of acid gastric contents, as it enters the duodenum, is rapidly neutralized by the alkaline solution dripped into the duodenum, and this prevents stimulation of the duodenal mechanism. On the other hand, when a markedly hypertonic alkaline solution is used, such as a 5 per cent solution of sodium bicarbonate, the duodenal mechanism is always stimulated so intensely that nothing leaves the stomach, and this occurs regardless of the concentration of acid secreted by the stomach (Fig 2). The same reaction was found to take place with other hypertonic electrolytes, such as solutions of sodium chloride. Hypertonic solutions of non-electrolytes were found (4, 11) to produce similar effects (Fig 3).

In other experiments (5) fats and fatty acids were found to be the most powerful stimulants of the duodenal mechanism, and this property of fats is important in understanding the basic part played by milk and cream in the treatment of duodenal ulcer (Fig 4).

Once the duodenal mechanism has been stimulated, whether by acids, hypertonic

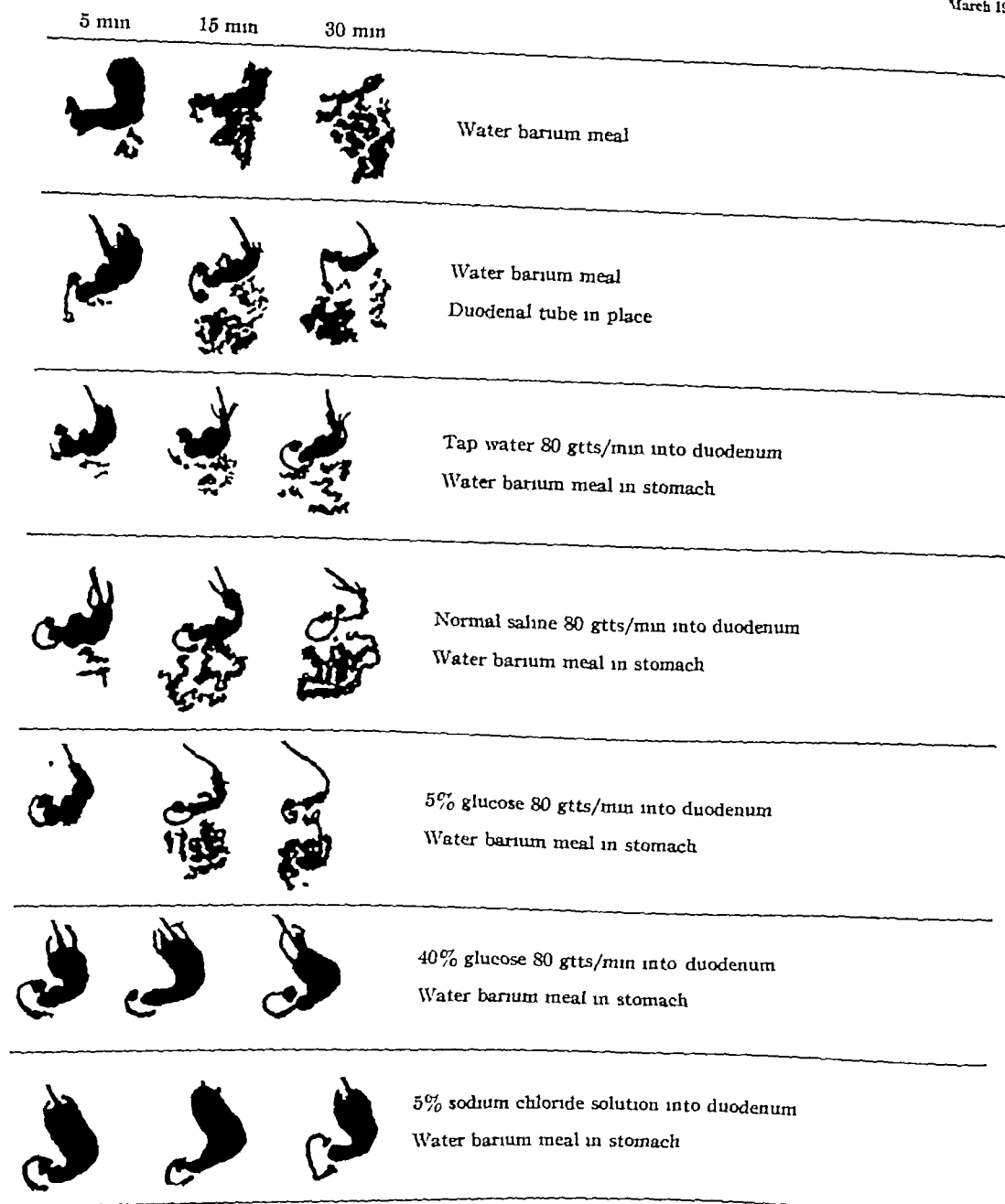


Fig 3 Hypertonic electrolytes and non-electrolytes stimulate the duodenal mechanism which results in retardation of gastric emptying

solutions of electrolytes or non-electrolytes, fats or fatty acids, and regardless of the different physiologic actions of these substances, the effects on gastric peristalsis and the action of the pylorus are always the same. Gastric peristalsis abates, the py-

lorus contracts, and emptying becomes retarded or ceases. The more intense the activator of the duodenal mechanism, the more marked is the pylorospasm and the more retarded is gastric emptying.

To determine further whether this is

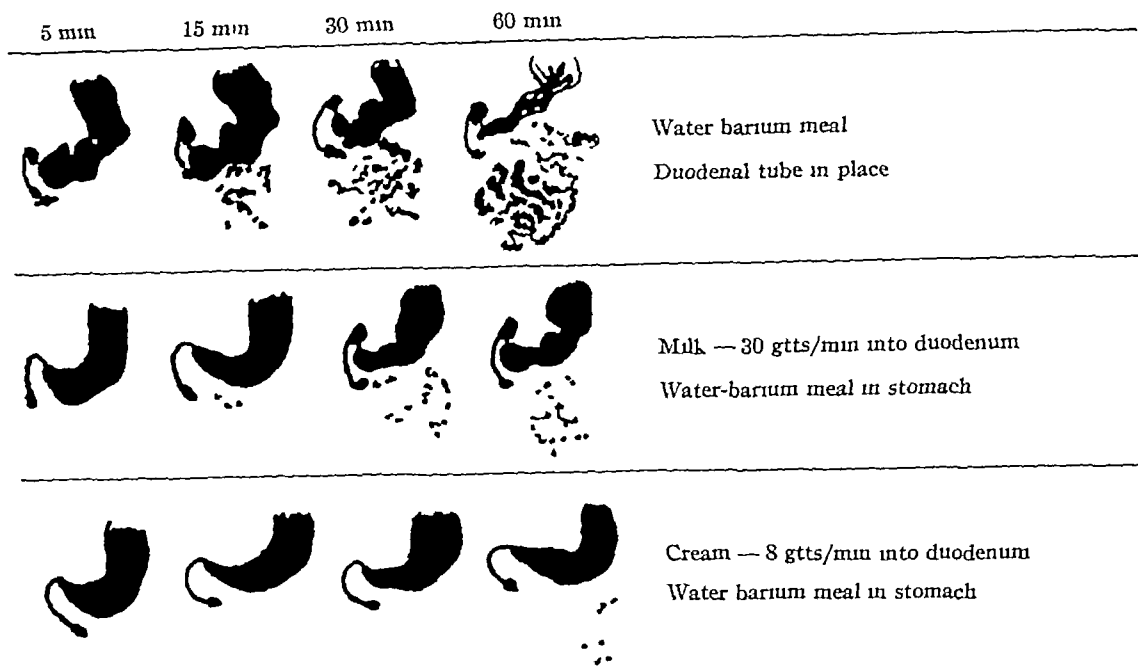


Fig 4 Milk and cream are active stimulators of the duodenal mechanism, which results in closure of the pylorus cessation of gastric peristalsis, and retention of the gastric meal The intensity of stimulation depends chiefly on the fat content of the milk or cream

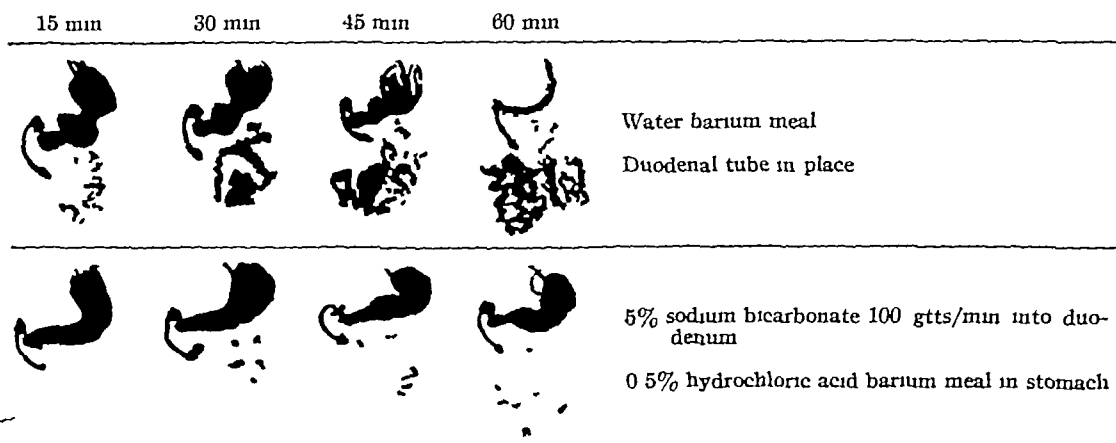


Fig 5 Acid on the gastric side causes opening of the pylorus according to Cannon's theory, but tight closure of this sphincter results when a hypertonic alkaline solution is placed in the duodenum, regardless of the presence of an acid solution on the gastric side of the pylorus

true in the presence of acid on the gastric side of the pylorus, in line with Cannon's theory, the following experiment was done in man. A hypertonic solution of 5 per cent sodium bicarbonate was dripped slowly into the duodenum. Then the gastric side of the pylorus was bathed by a 0.5 per cent hydrochloric acid meal,

but even though this arrangement was ideal for opening the pylorus according to Cannon's theory, gastric emptying was completely prevented. So long as the hypertonic alkaline solution was dripped into the duodenum, the pylorus remained tightly closed, gastric peristalsis remained in abeyance, and no evacuation of the acid

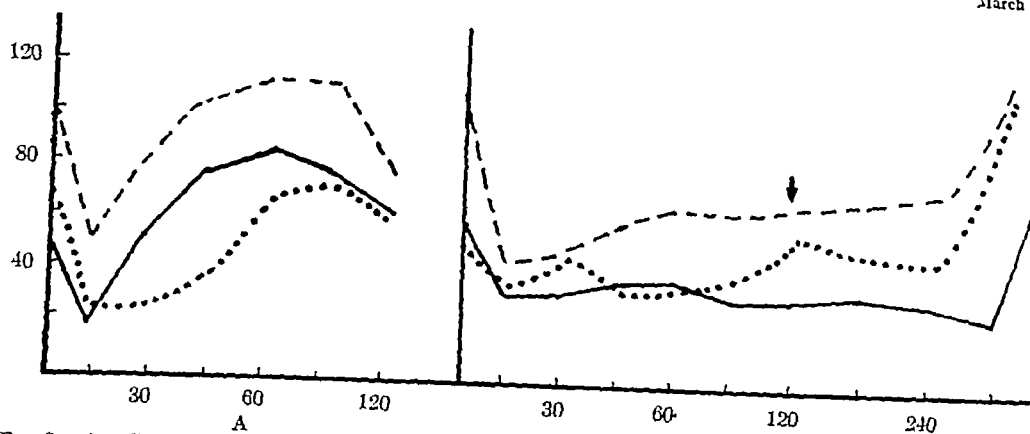


Fig 6 A Curves of gastric secretion of — total acid, - - chloride and . . . pepsin in a normal individual
 B Suppression of gastric secretions when the duodenal mechanism is stimulated by olive oil (40 gtt/min, Ewald meal by mouth) Oil stopped at point indicated by arrow

meal took place from the stomach (Fig 5) Thus it would seem that it is the reaction on the duodenal side rather than gastric side of the pylorus which governs gastric emptying

Stimulation of the duodenal mechanism produces not only pyloric closure and cessation of gastric peristalsis, but also diminution of gastric secretions, including acid, enzymes, and chlorides (10) This depression of secretion continues for a considerable period after the instillation of the stimulant has been stopped Figure 6 illustrates this depression when olive oil at 40 gtt/min is instilled into the duodenum The marked depression of all gastric secretions thus produced is followed by a sharp secondary rise after the effect of stimulation of the duodenal mechanism wears off

THE DUODENAL MECHANISM IN DUODENAL ULCER

The response of the duodenal mechanism is most sensitive in the duodenal cap The experiments which led to this conclusion revealed that the activation of this mechanism could be set up from any portion of the small intestine, but that the sensitivity of response decreased rapidly beyond the duodenal cap (8, 10) Ulcer of the duodenum is localized usually in the cap and, since this portion is the most responsive to stimulation, it can be appre-

ciated why duodenal ulcer so consistently causes alterations in the function of the duodenal mechanism If the duodenum is inflamed, normal stimuli seem to be insufficient for activation of the duodenal mechanism The brake-like effect on gastric emptying caused by normal stimulation of the duodenal mechanism is not initiated, and rapid gastric emptying takes place After healing of a duodenal ulcer, normal sensitivity to stimulation is recovered by the duodenum, and the gastric motor disturbances associated with the ulcer disappear

Likewise, during the active phase of a duodenal ulcer, when the threshold sensitivity of the duodenum seems impaired by the inflammatory processes, the peak gastric acid secretion induced by an Ewald meal is not sufficient to activate the duodenal mechanism This results in a prolonged hypersecretion Variations in this abnormal secretory curve might be due to differences in extent of the inflammation in the duodenum and thus account for the observation that small duodenal lesions cause a lesser increase in gastric acidity than do larger lesions with much perifocal inflammation (12) The fact that gastric acid levels return to normal when the duodenal ulcer heals may indicate that normal sensitivity of the duodenal mechanism has returned This has been demonstrated in the dog, where an in-

creased gastric acid response to a test meal produced by mechanical abrasion of the duodenum returned to normal on the ninth or tenth day, at which time the lesion was found at autopsy to have healed (7). In man, the reappearance of normal gastric motor activity and a normal acid secretory curve perhaps should be regarded as a more reliable indicator of complete healing of an ulcer than any other evidence obtainable (1). Reliance upon this evidence might lead to a better understanding of the numerous so-called recurrences which have come to be expected with the medical treatment of duodenal ulcer. It may be that most of these so-called recurrences are only exacerbations of incompletely healed lesions (6).

In the medical treatment of duodenal ulcer, milk and cream are the mainstays of the diet (3). If gastric hydrochloric acid and pepsin are important ulcerogenous factors contributing to the chronicity of ulcer, if not the prime initiator of this lesion, then the neutralization of the acid and the binding of the pepsin become of paramount importance. For this purpose, milk is an ideal food because its protein will bind pepsin and its buffer action in neutralizing acidity takes care of the hyperacidity. Fats are the most potent stimulants of the duodenal mechanism, and the fat content of milk and cream is well suited for effective activation of the duodenal mechanism when it is obtunded by the inflammatory process of duodenal ulcer. If the duodenal mechanism fails to respond to the fats in milk and cream, with persistence of abnormal gastric motor and secretory functions, even though there is a disappearance of symptoms and the ulcer niche in the x-ray films, the roentgenologist would seem well advised to guard his opinion about the healed state of an ulcer.

SUMMARY

1 The duodenum houses a mechanism influencing tone, peristalsis, pyloric action, and secretions of the stomach.

2 This mechanism can be activated

normally by gastric hydrochloric acid or by other chemical or physico-chemical substances such as hypertonic solutions of electrolytes or non-electrolytes, fats and fatty acids.

3 Stimulation of this mechanism by any of these agents produces suppression or cessation of gastric secretions, lowering of gastric tone, disappearance of gastric peristalsis, closure of the pyloric sphincter, and thus retardation of gastric emptying.

4 A critical threshold level of stimulation of the duodenal mechanism regulates the peak of gastric acid secretion. Because this threshold level is altered by the inflammatory processes of duodenal ulcer, characteristic disturbances in gastric motor and secretory activities take place.

5 Fat is the most potent stimulator of the duodenal mechanism and accounts chiefly for the value of milk and cream in the medical treatment of duodenal ulcer.

6 Disturbances in the duodenal mechanism persisting after the disappearance of symptoms and the ulcer niche in the x-ray films, should put the roentgenologist on guard against reporting the complete healing of duodenal ulcer.

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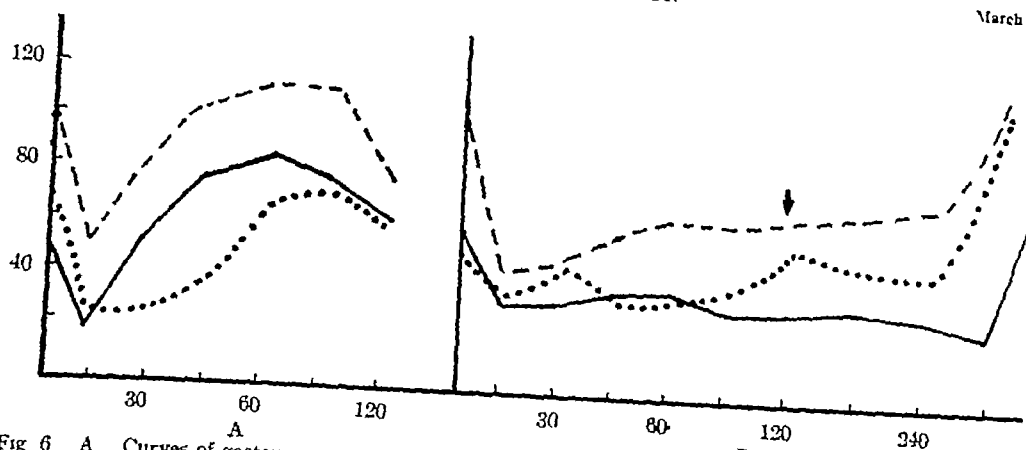


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Pericardial Celomic Cysts¹

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Detroit, Mich

IN THE PRESIDENTIAL address before the Twenty-Third Annual Meeting of the American Association for Thoracic Surgery at Cleveland in 1940, Lambert (1) spoke on "The Etiology of Thin-Walled Thoracic Cysts." Although his discussion was based on only four cases, two from the literature (2, 3) and two which had been reported to him by other surgeons (F. B. Berry and E. F. Butler), his explanation and name for this type of mediastinal cyst has been accepted without dissent.

An excellent review of cysts and cystic tumors of the mediastinum is that of Laipply (4). He listed eight kinds of congenital cysts: epidermoid, dermoid, teratoid, bronchial, esophageal, gastro-enteric and pericardial celomic cysts, and cystic lymphangioma. Only the last two, which are of purely mesodermal origin, will be considered here. These differ considerably in gross and histologic morphology. The cystic lymphangiomas have a complicated structure; they are multilocular and the cyst walls are of varying thickness. Sections of one such specimen (5) showed hyaline fibrous tissue with scattered clusters of fat cells, foci of lymphocytes, blood vessels, areas of smooth muscle fibers, and cystic spaces of various sizes lined with a single layer of flattened endothelium. As Lambert pointed out, the lymphangiomas are intimately incorporated with the surrounding structures; they receive their blood supply from all sides, and cannot be shelled out. Attempts at removal are often associated with severe hemorrhage. The infiltration gives the impression that they are of neoplastic origin. They may occur in any region of the thorax and elsewhere in the body.

On the other hand, those cysts which Lambert has named "pericardial celomic

cysts" are simple in structure. They are usually unilocular and are lined with a thin layer of mesothelium, which peels readily from the surrounding structures. The contained fluid is clear or sanguineous. The four cysts previously described and the one reported here have been adjacent to the pericardium. Lambert's explanation for these cysts is based on a consideration of the embryology of the pericardium. This structure arises from a series of disconnected lacunae which appear early in the life of the embryo. These lacunae in the mesenchyme remain for a time as individual spaces, but eventually coalesce to form the pericardial celom. If one of these lacunar cavities failed to merge, it could persist and give rise to a cyst in the vicinity of the pericardium, a pericardial celomic cyst.

Since only four cases have been reported, they can be reviewed briefly. Dufour and Mourrut (2) published the autopsy findings in a woman who died at the age of eighty-six years of cerebral softening. In the anterior mediastinum, in relation to the superior part of the pericardium, was a cyst containing 120 c.c. of reddish fluid. It was called a "lymphatic cyst." Pickhardt (3) removed a simple cyst measuring 8.9 cm. in diameter from the region of the diaphragm and pericardium of a fifty-three-year-old woman. There was also a smaller cyst, measuring 1.5 cm. in diameter. The two cysts described by Lambert (1) were similar. They had not produced symptoms and were removed after their presence was discovered on routine x-ray examination. One of them, which was removed by Dr. Ethan Flagg Butler, was described as follows: "Arising from the left anterior mediastinal diaphragmatic angle was a thin-walled cyst containing clear fluid,

¹ From the Division of General Surgery of the Henry Ford Hospital, Detroit, Mich. Accepted for publication in June 1946.

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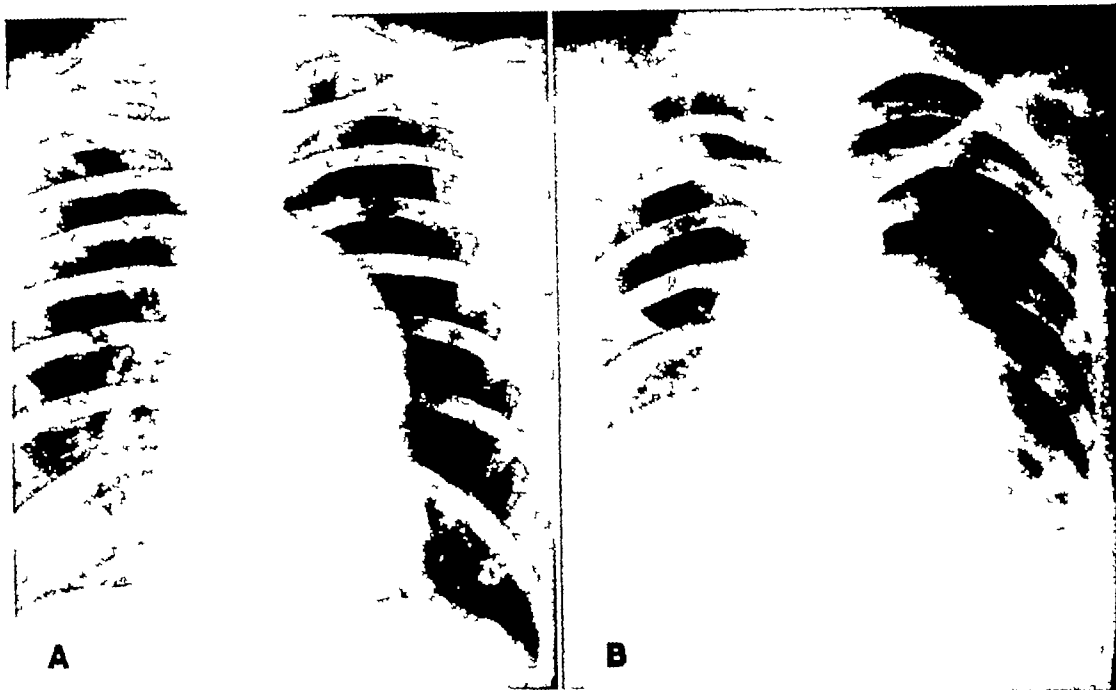


Fig 2 Roentgenograms taken Aug 22, 1938 in inspiration (A) and expiration (B)

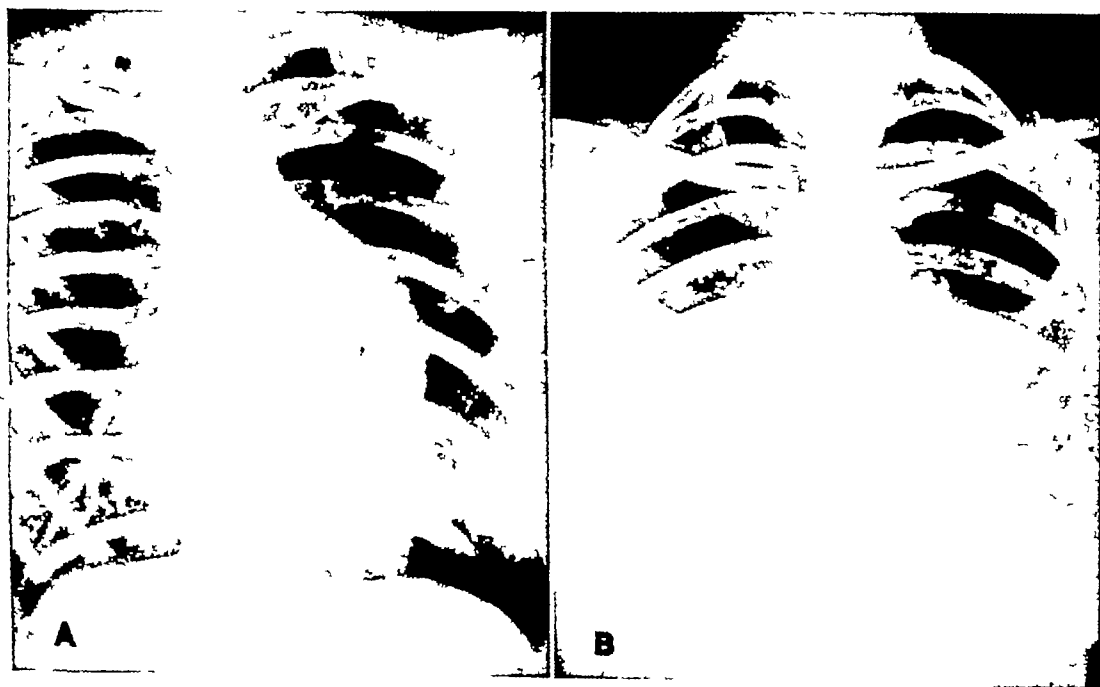


Fig 3 Roentgenograms taken April 14 1942 in inspiration (A) and expiration (B)



Fig 1 Roentgenogram of chest made Sept 17 1935. Note the thin curved shadow overlying the arch of the aorta.

approximately 12.5 cm long by 5 cm in diameter. If there was any vascular pedicle at all, it came from the diaphragm. It lay adjacent to but was not attached to the pericardium. As it bulged into the pleural cavity, it carried a coat of pleura with it. Its origin was definitely extra-pleural."

Two years ago, I had the opportunity to remove one of these pericardial celomic cysts. The case is of interest because it presented diagnostic difficulties which prevented the true nature of the disorder from being disclosed until operation, although symptoms had been present for ten years, and because the cyst was considerably larger than any thus far reported.

CASE REPORT

Mrs. E. P., a white woman, age 39, was admitted to the Henry Ford Hospital March 12, 1944. Her chief complaints were listed as low grade fever of ten years' duration, shortness of breath, and fatigue, and angina pectoris. She had been presumed to have heart disease for many years. When she was twelve years old, the family physician told her she had a 'leaky valve.' At the age of fifteen, she was advised not to become a nurse because of her heart. In 1934, when she was twenty-nine, she was obliged to discontinue her studies in a university because of poor health. She tried to do light work on the staff of

a newspaper but could not continue. In 1935, she had a thorough examination in a university clinic. The roentgenogram shown in Fig 1 was made. This was interpreted as follows: The cardiac contour is very unusual, with marked bulging in the region of the left pulmonary artery and the left auricular salient. The aortic arch is not well developed and the appearance is most suggestive of a congenital heart.

There are changes pointing definitely to an accentuated collateral circulation. This warrants a roentgen diagnosis of coarctation of the aorta.

The cardiologist in that clinic disagreed with the diagnosis of coarctation and stated: 'I have reviewed the films personally and we agreed that the peculiar bulge in the region of the upper left mediastinum appeared to be a part of the heart shadow. I could find absolutely no physical evidence of any valve lesion or other cardiac lesion. The x-ray appearance, if the shadow is cardiac, can only be explained as a congenital anomaly. Clinically, one can be certain that it is not a coarctation of the aorta because of perfectly good pulsations in the abdominal aorta and the lower extremities.' The patient was advised that the anomaly could be disregarded from a practical standpoint. No cause could be found for the low grade fever which she had even at that time, it was suggested that it might be due to a functional disturbance of the heat-regulating center in the central nervous system.

From 1936 until 1944, the patient was under the care of another cardiologist. During that time, she carried the diagnosis of congenital heart disease. Roentgenograms taken in August 1938 (Fig 2) showed a significant increase in the size of the apparent cardiac shadow. Beginning in 1941, severe anginal attacks occurred, which required morphine for relief. The shadow in the chest became alarmingly large (Fig 3). The patient gradually became completely incapacitated and during the year preceding her admission to the Henry Ford Hospital she was in bed most of the time. She had continued to have fever intermittently.

The clinical studies in the Henry Ford Hospital were under the direction of Dr. Robert Ziegler. The findings on physical examination were not striking. The patient was well developed and nourished. The lungs were clear. Percussion of the heart showed enlargement of the area of cardiac dullness to the right. The rhythm was regular. The mitral first sound was described as rough, there was no definite murmur. The blood pressure was 130/90. The venous pressure was 18 cm of water. Circulation time with decholin was 15 seconds, with ether 9 seconds. The electrocardiogram showed slight left axis deviation. Fluoroscopy of the heart indicated a transverse diameter of the chest of 28 cm and of the supposed cardiac shadow of 21.4 cm as compared with a predicted transverse cardiac diameter of 12.3 cm.

Roentgen examination of the chest included films made with the patient in the postero-anterior, left anterior oblique, and right lateral positions (Fig 4).

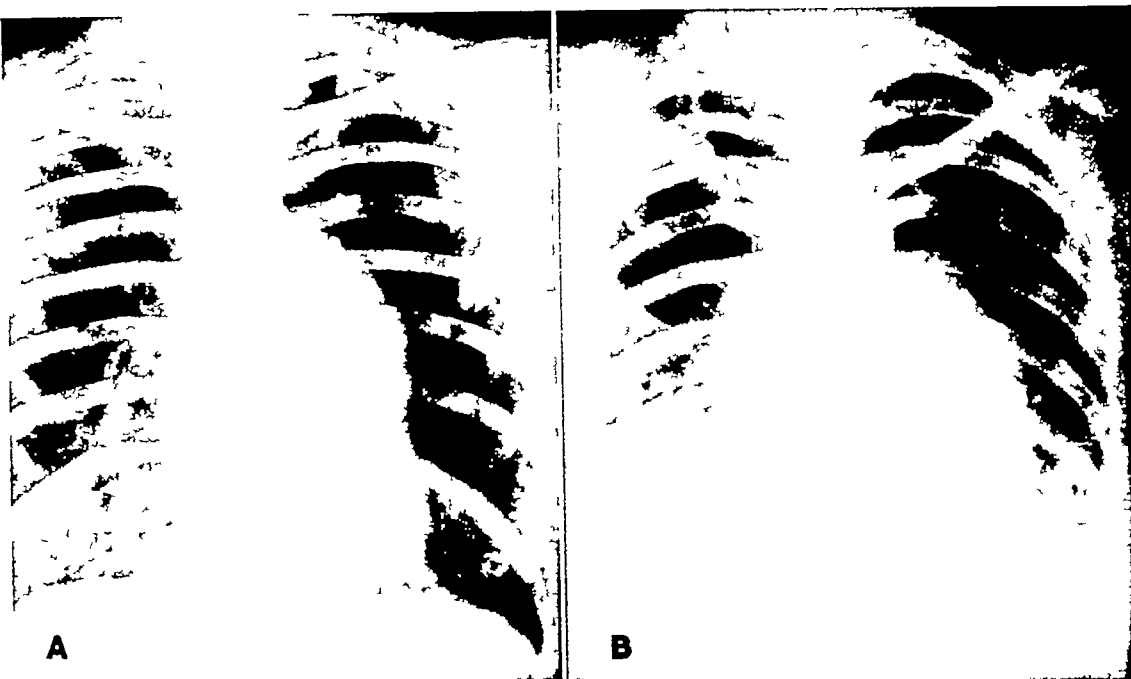


Fig 2 Roentgenograms taken Aug 22 1938 in inspiration (A) and expiration (B)

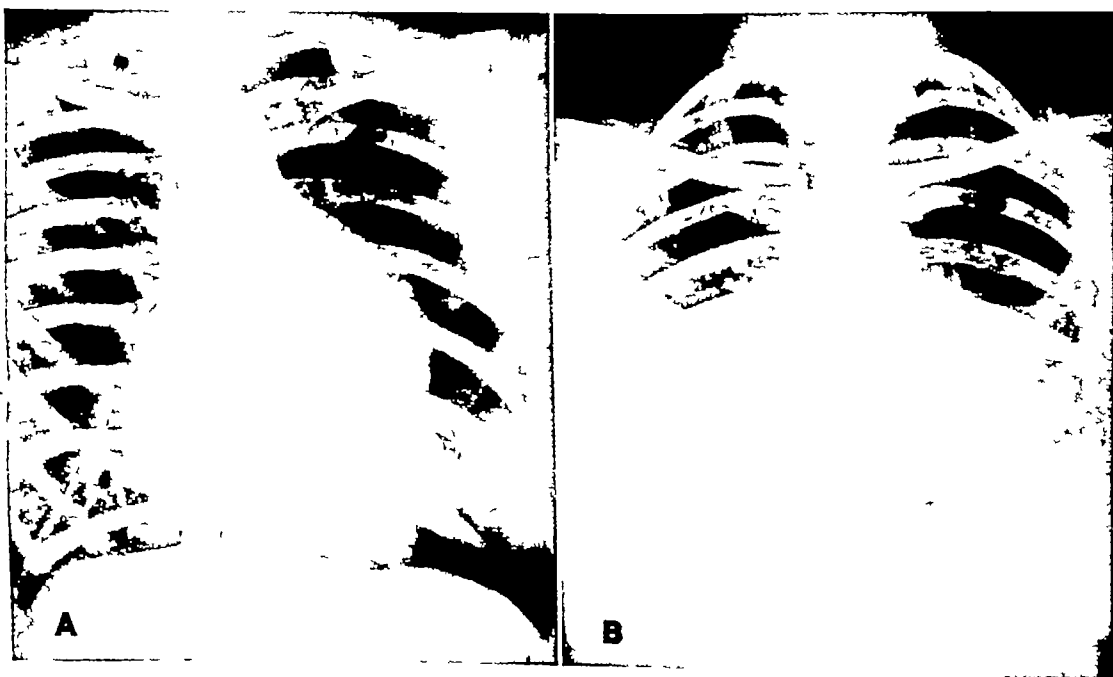


Fig 3 Roentgenograms taken April 14 1942 in inspiration (A) and expiration (B)

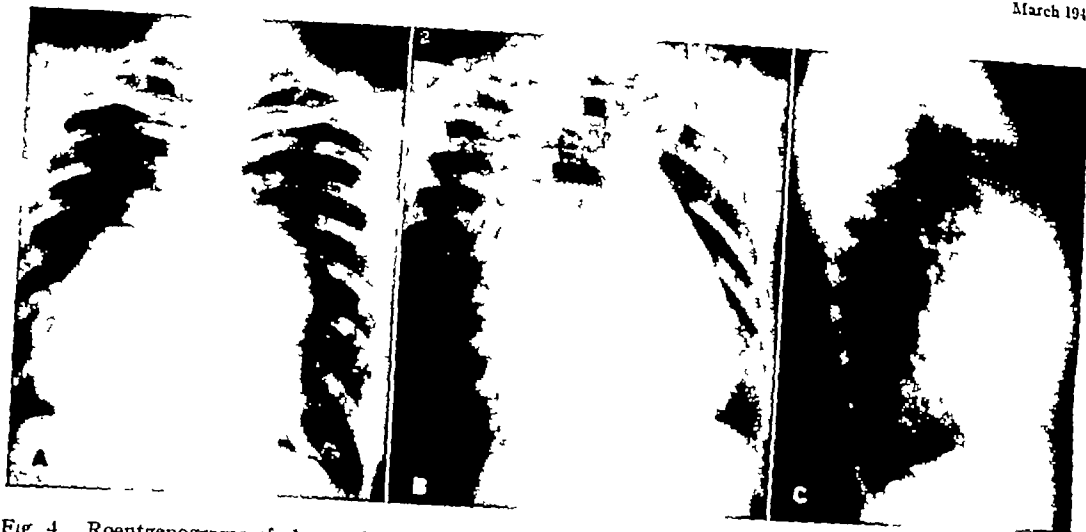


Fig. 4 Roentgenograms of chest taken on March 13, 1944 A Postero-anterior B Left anterior oblique C Right lateral

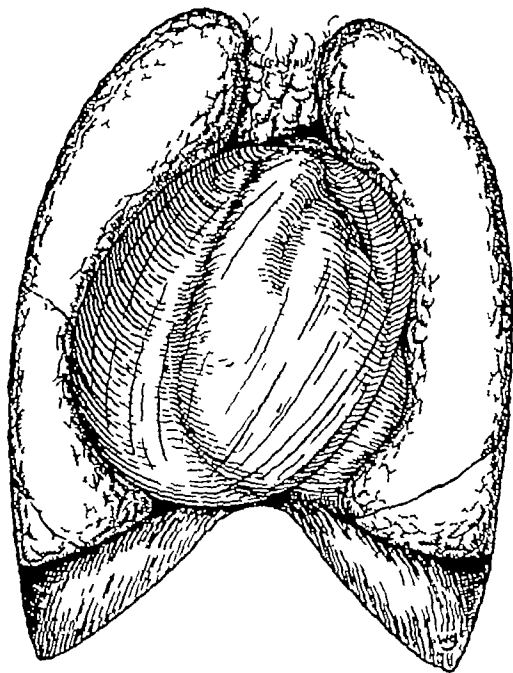


Fig. 5 Semidiagrammatic impression of the unopened cyst as it would have appeared if the anterior thoracic wall had been lifted away

The roentgenologist reported as follows: 'There is evidence of a large shadow of increased density occupying the lower portion of the chest, partly obliterating the heart shadow. This extends out on the left side from an area in the region of the aortic knuckle down to about the tenth interspace posteriorly. There is also a large shadow of increased density extending out into the right chest, especially at the base of the chest. In the oblique position and in the

lateral position, this seems to lie in the posterior portion of the chest. Fluoroscopically, no pulsation of the mass is seen. The cardiac shadow pulsates in a normal manner. *Impression:* These findings suggest a large tumor overlying part of the heart and slightly posterior to it. We could not definitely say what type of tumor this is. From its size, the possibility of lymphoblastoma or of some large cyst would have to be considered.

Operation was carried out on May 17, 1944. The thorax was entered through an incision in the sixth interspace on the right. When the lung was retracted to reveal the tumor, the latter was found to be a huge thin-walled cyst lying in the mediastinum anterior to the heart and great vessels. It projected out around the heart so far on the right that a portion of it actually lay in a plane posterior to the heart, accounting for the roentgen picture in the lateral projection (Fig. 4, C). The pleura over the cyst was carefully incised, after which an excellent plane of cleavage between the pleura and the cyst wall was easily developed. It was thought that it might be possible to excise the cyst intact but, before the dissection had progressed very far, the thin wall ruptured and permitted about a liter of clear straw-colored fluid to escape. After the removal of the fluid from the pleural cavity by suction, it was found that the removal of the cyst was greatly facilitated by the evacuation of its contents. The hand could be placed inside the structure, and exploration revealed that it extended over the entire anterior surface of the pericardium and great vessels (Fig. 5). The outline of the arch of the aorta could be palpated easily. The thin lining of the cyst was stripped out of its position exactly as one would strip out the sac of a large scrotal hernia. No bleeding was encountered, since there was no pedicle or other vascular attachment of importance. After the removal of the cyst lining, the opening in the medi-

astinal pleura fell together and no suturing was done. The condition of the patient following closure of the thoracotomy wound was excellent.

The pathologic report on the excised tissue (by Dr P C Gillette) was as follows: "The specimen consists of three strips of areolar tissue, one side of which is apparently covered with thin epithelium. The pieces cover an area of 10 inches by 15 inches. *Microscopic* The cyst has no epithelial lining. The wall is composed of areolar tissue throughout which are distributed many vascular channels, some islands of adipose tissue, and some islands of round cells. Nothing specific is noted in the cyst. *Impression* Simple mediastinal cyst."

The postoperative film of the chest showed an absence of the large shadow seen previously (Fig 6). The patient was discharged on June 10, 1944. In September, she stated that she felt exceptionally well except for her usual bouts of fever. The cause of these febrile attacks remains unknown in spite of extensive studies.

In retrospect, the roentgenograms of this patient in 1938 and 1942 show a sign which may very well be pathognomonic for a pericardial celomic cyst in this location. This sign is the marked change in the contour of the mass produced by the two phases of respiration (Figs 2 and 3).

SUMMARY

Attention has been directed to a type of mediastinal cyst which has been called pericardial celomic by Lambert. A case report of a patient who had an unusually large cyst of this kind has been presented. Roentgenograms showing the cyst at various stages of development were available.

The Henry Ford Hospital
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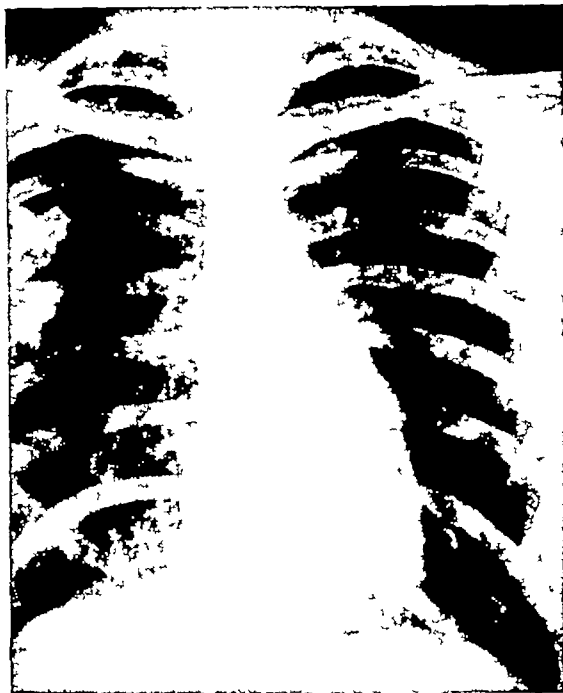


Fig 6 Roentgenogram of chest soon after operation. Note the unhealed osteotomies of the sixth and seventh ribs on the right.

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Gastrocolic Fistula Complicating Carcinoma of the Colon

A Case Report¹

MAJ PETER ZANCA, M C, A U S

GASTROCOLIC FISTULA has long been established as a distinct clinical entity. Although it is rare in occurrence, many isolated cases have been reported in the literature. The condition exists only as a complication to other primary gastrointestinal or intra-abdominal lesions.

The characteristic symptoms of gastrocolic fistula are fecal vomiting in the absence of symptoms of intestinal obstruction, eructation of foul gas, a fecal odor to the breath, general weakness, extreme loss of weight, and persistent diarrhea with undigested food particles in the stools. The diagnosis can safely be made when fecal vomiting occurs in the absence of intestinal obstruction. However, because of the variable symptomatology resulting from the different primary lesions, clinical diagnosis sometimes becomes difficult and roentgen study may be required. By means of the barium meal, barium enema, and double contrast enema the diagnosis of gastrocolic fistula can be established easily and definitely.

CASE REPORT

A 37 year old white male was admitted to the Station Hospital on March 14, 1946, complaining of rectal bleeding, abdominal pain, diarrhea, general weakness, and a mass in the left upper abdomen.

Past History The patient had always been well and had worked as a waiter for nine years prior to induction into the Army in 1942. After eight months of military service he was discharged for severe varicose veins of both lower extremities. A chronic alcoholic he drank a pint of whiskey and consumed one to two packages of cigarettes daily. He denied having had any venereal disease.

The family history was essentially negative.

History of Present Illness Seven months prior to admission the patient had an attack of severe abdominal pain and cramps. Treated symptomatically, he improved and returned to work in one week. From that time on, he had had recurrent attacks of abdominal pain, showing no relation to meals. His appetite was extremely poor and he preferred drink-



Fig 1 Gastrocolic fistula secondary to carcinoma of the colon demonstrated following a barium meal examination. There is a broad irregular communication between the stomach and colon.

ing to eating. On two or three occasions after the middle of February 1946, there had been vomiting of some coffee ground material and dark bloody streaks had been observed in the stools. In the early part of February, the patient noticed a large mass in the left upper abdomen which was somewhat annoying but not painful. His bowel movements had been regular until diarrhea developed two days prior to admission to the hospital. He had been steadily losing weight and had grown progressively weaker. On admission he was unable to stand.

On *physical examination* the patient appeared critically ill. He was very pale, weak, dehydrated, and cachectic. His blood pressure was 108/58, pulse 112, respirations 22, and temperature 99.4°. The abdomen was slightly distended and in the left upper quadrant just beneath the anterior costal margin, was a smooth, rounded mass, about 8 cm in diameter which was mildly tender on palpation. Several small, shotty, freely movable, non-tender axillary and inguinal nodes were present. Otherwise, the physical findings were normal.

¹ From the Roentgenological Service, Station Hospital, West Point, N. Y. Accepted for publication in June 1946.

Laboratory Data On admission blood studies showed red cells 2,330,000, hemoglobin 5.8 gm, white cells 15,400 (neutrophils 84 per cent, lymphocytes 11 per cent), platelet count 260,000. There were marked hypochromia and anisocytosis. Clotting time was 3 minutes, bleeding time 1.5 minutes. Serum protein was 6.3 gm per 100 cc. The Kahn

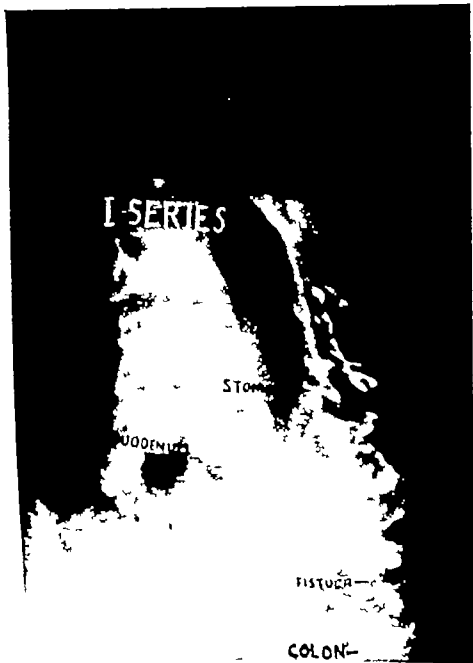


Fig 2 Film made following a barium meal. The opaque medium can be seen filling the fistulous tract and emptying into the colon. The gastric rugae are coarse and irregular. There is a partial filling of the stomach and of the duodenal bulb.

reaction was negative. Occult blood (+++) was present in the stool. Urinalysis was negative. Gastric analysis showed a total acidity of 130 and free hydrochloric acid 110, following histamine.

X-ray Findings Fluoroscopically the esophagus appeared normal. There was immediate filling of the descending colon, and only a small portion of the barium meal passed into the duodenum, outlining a normal duodenal bulb. There was an irregular filling defect of the pars media, involving the greater curvature of the stomach. The barium passed from this region through a long, irregular tract into the splenic flexure of the colon. The greater part of the gastric mucosa appeared coarse and irregular. Films (Figs 1 and 2) confirmed the fluoroscopic findings. At six hours there was no gastric residue, and the head of the barium was in the cecum. The gastrocolic tract remained filled with the opaque medium, the distal third of the transverse colon and the upper portion of the descending colon were also filled with barium.

Following a barium enema there was normal filling

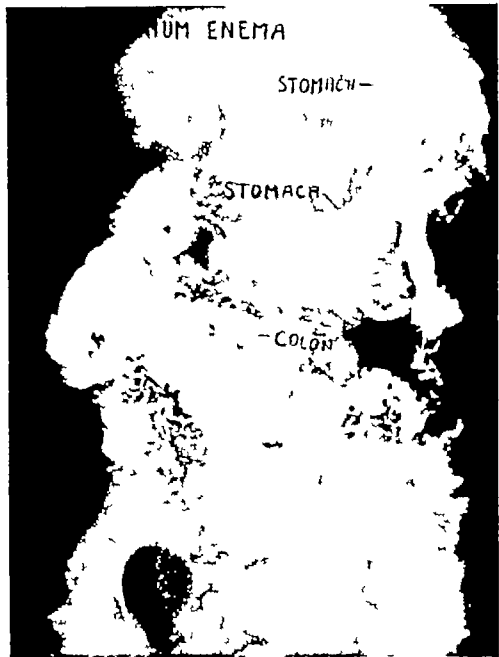


Fig 3 Barium enema study. Note filling defect in region of greater curvature of stomach. The fistula can be seen leading from this defect to the colon. An irregular filling defect and constriction of the splenic flexure are also seen.

of the rectum and descending colon to the level of the splenic flexure. A small part of the barium passed through the transverse colon into the ascending colon and to the cecum. An irregular filling defect and constriction in the region of the splenic flexure, from which a stream of barium extended upward into the midportion of the stomach, was seen (Fig 3), and a firm, non-tender, abdominal mass could be palpated in this region. Except for a small area in the pars media, the stomach also filled with barium, and a smaller amount of the opaque medium passed into the duodenum.

After evacuation of the barium, air was injected into the colon and a gastrocolic communication was plainly visualized (Fig 4). A moderate amount of gas could be seen throughout the colon, stomach, and duodenum.

A roentgenogram of the chest was negative.

Diagnosis of gastrocolic fistula secondary to carcinoma of the stomach and colon was made. The patient received 1,050 cc of whole, citrated blood, there was improvement in his general condition, and operation was performed on April 10, 1946, by Lt Col H Genvert.

Operative Findings In the left upper quadrant there was a large adherent mass which involved the greater portion of the posterior wall of the stomach and the distal end of the transverse colon, including the splenic flexure. The mass was fixed to the body of the pancreas and to the retroperitoneal nodes. There was no evidence of metastasis to the

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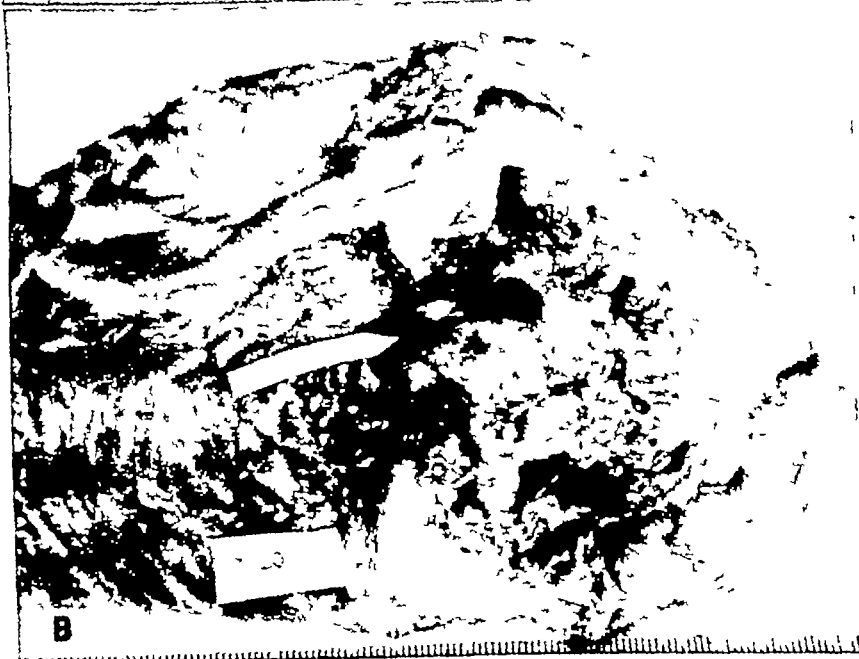


Fig 6 A Stomach opened showing the two fistulous openings, the darker rounded opening is the lesser one and communicates with the major fistulous tract about 1 cm from its gastric end
 B Transverse colon open showing annular ulcerating carcinoma of the colon Arrow points to the fistulous opening at the base of the tumor



Fig 4 Roentgenogram obtained following partial evacuation of the barium and injection of air into the colon. Note the air in the descending colon. The fistulous tract is clearly outlined and there is a partial filling of the stomach with gas.

liver, and the pelvis was negative. A gastric resection and a resection of the splenic flexure were performed. A Polya anterior gastro-enterostomy and an end-to-end anastomosis of the transverse colon to the descending colon completed the operation.

Pathological Findings The gross specimen (Fig 5), consisting of a portion of resected stomach and colon, measured approximately 15 X 20 cm. The stomach and colon were densely attached to each other by a firm mass measuring 8 cm in its greatest diameter. When the stomach was opened (Fig 6, A), there were found two openings along the greater curvature, the larger measuring 1.5 cm in diameter and leading into one fistulous tract, which communicated with the colon. On opening the colon (Fig 6, B), there was found an annular ulcerated neoplasm at the base of which was the opening of the fistula. The fistulous tract was lined with tumor tissue. Microscopic examination revealed an adenocarcinoma of the colon. Sections through the fistulous tract showed it to consist of carcinomatous material. The stomach wall was infiltrated from within.

Progress of Case The patient received 1,500 c.c. of whole, citrated blood following operation, and on April 25 the blood count was: red cells 3,600,000; white cells 13,000 (neutrophils 67 per cent, lymphocytes 7 per cent, eosinophils 2 per cent, stab



Fig 5 Stomach, fistulous tract and colon showing the communication between the two organs. The tract measures about 5.5 cm in length and is composed entirely of neoplastic tissue.

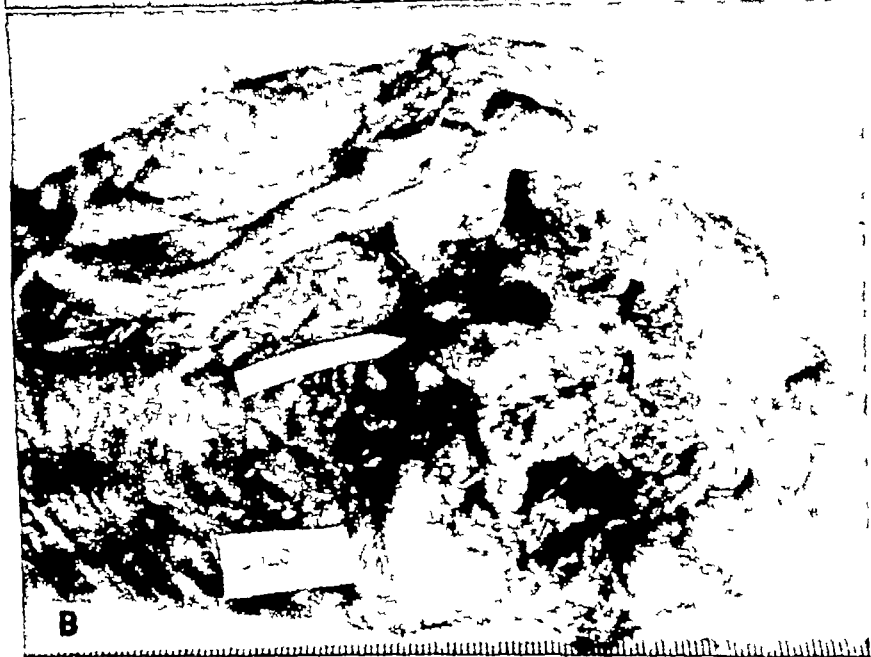


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forms 19 per cent, juvenile forms 2 per cent, myelocytes 3 per cent) Hemoglobin was 9.5 grams On the third postoperative day a post-anesthetic pneumonia and pleurisy with effusion developed The condition, however, improved rapidly and on May 5, 1946, the patient was up and around At the time of this report he is eating well, has gained ten pounds, has no complaints, and is awaiting discharge from the hospital

DISCUSSION

An intra-abdominal mass, rectal bleeding, abdominal pain, diarrhea, severe weight loss, anemia, and general weakness were among the symptoms which suggested gastro-intestinal disease, clinically The pathognomonic signs of foul breath and of fecal vomiting were not present and the diagnosis was deferred until an x-ray study was done Any or all of the symptoms present in this case may occur in the presence of a solitary primary lesion The history of chronic alcoholism, the moderate gastric complaints, and the anemia served only to mask the cardinal symptoms of the disease

Roentgen examinations with the aid of a barium meal, barium enema, and double contrast enema, in each instance conclusively demonstrated the presence of a gastrocolic fistulous tract At the same time, the filling defects of the stomach and colon suggested the existence of the underlying primary cancer The fistulous tract was the result of chronic invasion of the stomach wall by neoplastic tissues from the splenic flexure of the colon This large opening easily allowed the opaque medium to flow from the stomach directly into the colon during the barium meal examination The flow of barium from the colon into the stomach during the enema was also easily accomplished

In the presence of a ball-valve type of fistula, routine study of the gastro-intestinal tract may not suffice in demonstrating the presence of perforation It is, important, therefore, to include the double contrast enema as part of the roentgen examination The entire fistulous communication will be visualized after the colon has

been inflated with air This procedure will also permit the radiologist to detect the foul and fecaloid odor emanating from the patient's mouth

The prognosis in this type of case is poor Surgery will afford immediate relief, however, and the patient may look forward to several symptomless years

SUMMARY

A case of gastrocolic fistula secondary to carcinoma of the colon is reported

Clinical diagnosis of gastrocolic fistula is difficult to make because of the variable symptoms dependent upon the primary lesion, or absence of symptoms altogether

Complete x-ray studies of the gastro-intestinal tract by means of barium meal, barium enema, and double contrast enema, will definitely establish a diagnosis of gastrocolic fistula

NOTE The author wishes to express his thanks to the pathologist, Captain B Stempel, MC for the excellent demonstration of the pathologic specimen, to the Signal Corps Service of West Point for their fine photographs and to the x-ray technicians, Sgt G N Burnett and Mr Robert E Hennessey

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Rheumatic Mitral Valve Disease Without Cardiac Enlargement¹

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IN THE DIAGNOSIS of mitral valve disease, radiologic aid is frequently sought. This is usually based on the various roentgen evidences of change in the size or contour of the heart. Although these observations may be variable and may be simulated by a variety of other conditions (1), the usual teaching at the present time is that telerradiographic examination reveals prominence of the second left cardiac arc due to prominence of the pulmonary artery and the appearance of the conus arteriosus of the right ventricle on the left heart border. Further radiologic examination in the right anterior oblique position, after the administration of a barium bolus, shows posterior displacement of the esophagus, indicative of left atrial dilatation, usually ascribed to the hemodynamic changes caused by the malformation of the mitral valve. Left atrial dilatation is considered by some to be next in importance only to the pathognomonic apical diastolic murmur as a criterion for the diagnosis of mitral valve disease (2).

Various measurements of the frontal silhouette of the heart viewed telerradiographically are often used for the determination of cardiac enlargement. The most reliable of these are the Ungerleider and Gubner charts and nomograms, which are reported to be the only measurements which can identify as little cardiac enlargement as 40 per cent above the normal heart weight (3). Ungerleider presents these methods as two simple and accurate procedures whereby the presence of cardiac enlargement may be determined, and also states that cardiac fluoroscopy is an invaluable aid in the diagnosis of chamber enlargement (4).

Recently mention was made of the fact that dilatation of the left atrium may exist

in certain cases of rheumatic mitral valve disease without visible or arithmetic changes in the frontal silhouette of the heart (5). In these patients left atrial dilatation may be demonstrated only by the posterior displacement of the esophagus viewed in the right anterior oblique position. This was considered to be the earliest radiologic sign of mitral valve disease and incidentally poses the question whether dilatation of any chamber of the heart should not be considered indicative of enlargement, whether or not it might be identified by any of the methods of cardiac mensuration.

The purpose of this communication is to report a group of cases with the classical systolic and diastolic murmurs of mitral valve disease but without any radiologic evidence of cardiac enlargement. These were selected from a larger group with sufficient but not absolutely definite evidence of mitral valve disease. The latter group likewise presented no radiologic evidence of cardiac enlargement. It is emphasized that under these conditions the radiologist should report only that the heart is neither visibly enlarged nor altered in contour, he should not attempt to pass on the existence of organic heart disease on the basis of his findings alone. The advantages of knowing the limitations of any method of examination are obvious (6).

MATERIAL AND OBSERVATIONS

There were 25 patients in this group, in whom the diagnosis of mitral valve disease was made during routine hospital work in approximately four years. Sixteen were in-patients and 9 were referred for examination from the out-patient department. There were 17 females and 8 males, ranging from ten to sixty-three years old.

¹ From the Radiologic Service of M G Wasch M D The Jewish Hospital of Brooklyn Brooklyn N Y
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Fig 1 Case 1 A (left) Teleroentgenogram of the chest no cardiac enlargement B (right) Right anterior oblique esophagram, no displacement of the esophagus

Twenty patients had positive histories of rheumatic fever, 2 had had episodes of chorea only, and 3 had no known rheumatic infection. The duration of known heart disease varied from less than a year in 3 cases to over twenty years. Seventeen patients had been aware of heart disease for more than five years. The murmurs presented by all the patients in the group were considered definitely diagnostic of mitral valve disease. Classical mitral systolic and diastolic murmurs were audible in 20 cases, and in 3 there were variable murmurs, the quality varying from long, loud, blowing apical systolic murmurs to systolic and diastolic murmurs. Two patients, both with subacute bacterial endocarditis, had long, loud, blowing apical systolic murmurs.

The blood pressure readings were within normal limits in the entire group. Electrocardiographic examinations were available in 20 instances and, with the exception of one patient with subacute bacterial endocarditis who had right axis deviation, no significant changes were noted in any of these. Congestive heart failure was not encountered except in one patient who had

dyspnea on exertion during the last trimester of her third pregnancy.

There were 7 patients with proved subacute bacterial endocarditis. Of these, 5 responded to penicillin-heparin therapy administered by Dr Leo Loewe. Two patients died, but autopsy permission was denied.

Radiologic examinations of the chest included fluoroscopy, telerradiography, and esophagrams in the right anterior oblique position after preliminary fluoroscopic study. The heart contour as viewed on telerradiographic examination in the postero-anterior position was normal in each instance. Measurements made according to the method of Newcomer and Newcomer (7) were normal in every case. Information as to the height and weight was available in 12 cases, and measurements made according to the Ungerleider and Gubner nomograms for the area and transverse diameter of the frontal heart silhouette were normal in these patients. Fluoroscopic examination showed no visible changes in the pulsations of the heart except for some increased activity of pulsation in some of the patients with subacute



Fig 2 Case 2 A (left) Teleroentgenogram of the chest, no cardiac enlargement B (right) Right anterior oblique esophagram, no displacement of the esophagus

bacterial endocarditis who were quite ill at the time of examination. There was no displacement of the esophagus either dorsally or to the right in any patient in this group, nor was there any displacement of the left main bronchus. None of the patients presented a double right cardiac contour.

The absence of congestive heart failure in this group of patients supports the concept that the heart rarely fails while it is normal in size.

REPORT OF ILLUSTRATIVE CASES

CASE 1 S D female, aged 25 years had chorea at the age of twelve, following which a cardiac murmur was present for one year and then disappeared. She was admitted to the hospital because of anorexia, palpitation of the heart, and a sensation of nervousness and flushing.

Physical examination revealed a presystolic rumble at the apex, especially with the patient in the left lateral position, and a definite presystolic thrill. Blood pressure was 124/60. The rhythm was regular, rate 84 per minute.

Electrocardiographic examination was reported as within normal limits.

Fluoroscopic examination of the heart revealed no evidence of chamber enlargement. The barium-filled esophagus was not shifted from its usual course. The pulsations of the heart and great vessels were

within normal limits. The lungs were clear. Teleroadiographic examination of the chest showed no change of pathologic significance in the heart or lungs.

The patient's height was 157 cm., and her weight was 46 kg. The predicted surface area according to the Ungerleider and Gubner nomogram was 100 sq cm., the actual surface area was 94 sq cm. The predicted transverse diameter was 108 mm., the actual transverse diameter was 97 mm. The heart-lung ratio was 21 per cent.

The patient was discharged with a diagnosis of a psychosomatic disorder and inactive rheumatic mitral valve disease.

CASE 2 J M, male, aged 15 years, was referred to the outpatient department for evaluation of his cardiac status. At the age of eleven he had rheumatic fever which confined him to bed for two years. The disease was manifested by intermittent fever with painful swelling of the ankle, wrist, knee, and elbow joints and classical mitral systolic and diastolic murmurs. For the past two years he had been symptom free, but recently he had experienced palpitation and some shortness of breath on exertion.

Physical examination revealed a loud systolic murmur at the apex with accentuation of the second pulmonic sound. There were no objective evidences of congestive heart failure.

Fluoroscopic and radiographic examination of the chest showed no evidence of alteration of the silhouette of the heart or individual chamber enlargement. The barium-filled esophagus was not deviated from its usual course.

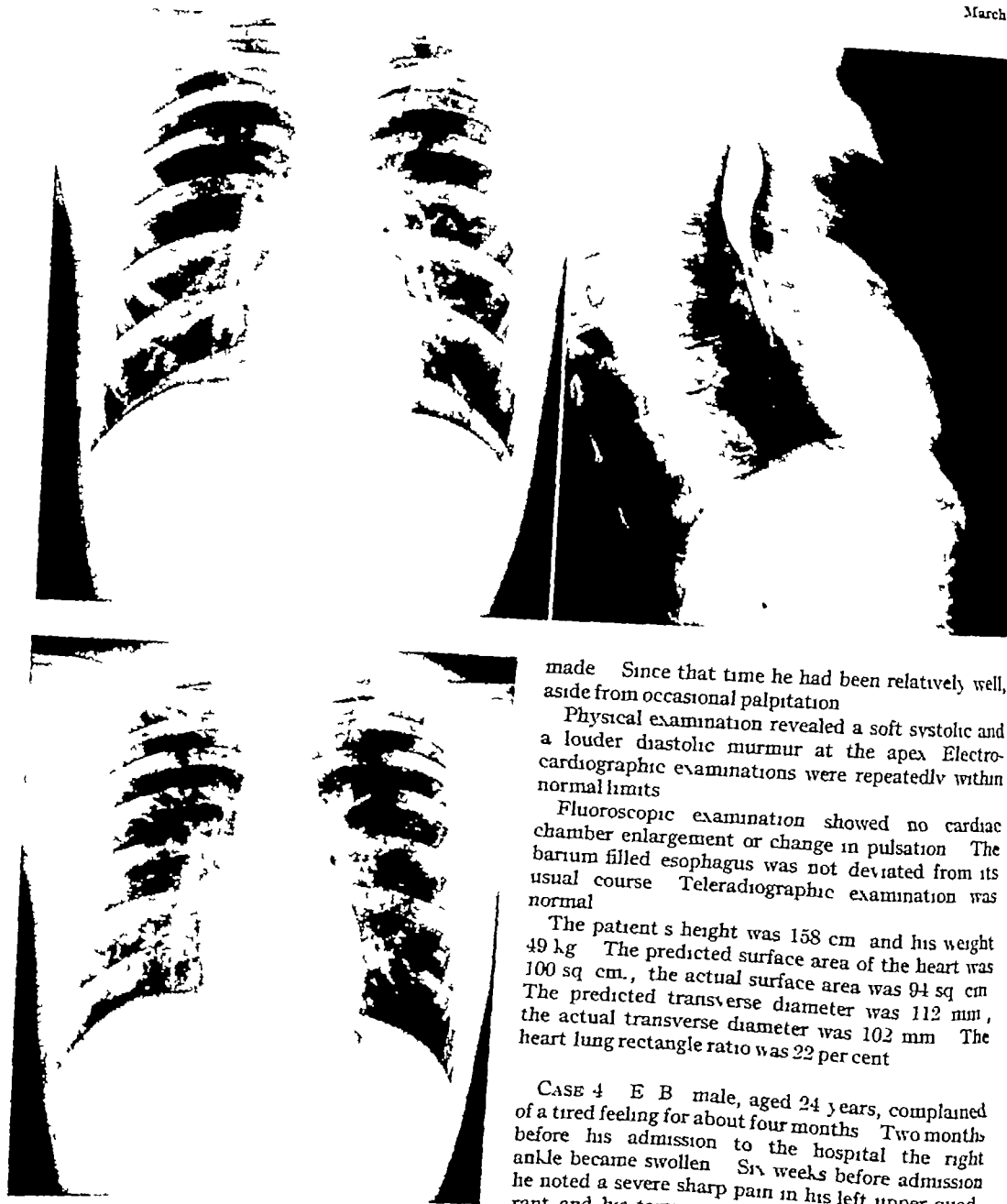


Fig 3 Case 3 A (upper left) Teleroentgenogram of the chest no cardiac enlargement B (right) Right anterior oblique esophagram no displacement of the esophagus C (lower left) Teleroentgenogram taken fifteen months after that in A. No change has occurred in the shape or size of the heart.

CASE 3 M F, male, aged 23 years, had his first rheumatic episode at the age of thirteen years, when he was hospitalized for one year and a diagnosis of mitral valve disease was

made. Since that time he had been relatively well, aside from occasional palpitation.

Physical examination revealed a soft systolic and a louder diastolic murmur at the apex. Electrocardiographic examinations were repeatedly within normal limits.

Fluoroscopic examination showed no cardiac chamber enlargement or change in pulsation. The barium filled esophagus was not deviated from its usual course. Teleradiographic examination was normal.

The patient's height was 158 cm and his weight 49 kg. The predicted surface area of the heart was 100 sq cm., the actual surface area was 94 sq cm. The predicted transverse diameter was 112 mm., the actual transverse diameter was 102 mm. The heart lung rectangle ratio was 22 per cent.

CASE 4 E B male, aged 24 years, complained of a tired feeling for about four months. Two months before his admission to the hospital the right ankle became swollen. Six weeks before admission he noted a severe sharp pain in his left upper quadrant and his temperature rose to 102° . The pain subsided after two days but fever persisted. There had been a weight loss of about 20 pounds in the past three months.

There was no past history of rheumatic fever, and the patient had been completely unaware of any cardiac disease. About two weeks before admission an apical diastolic murmur was heard. Blood culture was positive for *Streptococcus viridans*. Penicillin heparin therapy was administered and the patient made a satisfactory recovery. He was discharged ten weeks after admission in good condition.



Fig 4 Case 4 A (right) Teleroentgenogram of the chest, no cardiac enlargement B (left) Right anterior oblique esophagram, no displacement of the esophagus

Fluoroscopic and teleradiographic examination of his chest showed no evidence of enlargement of the heart and no change in the normal course of the esophagus

The patient's height was 178 cm. and his weight 79 kg. The predicted surface area of the heart was 130 sq cm, the actual surface area was 118 sq cm. The predicted transverse diameter of the heart was 133 mm, the actual transverse diameter was 122 mm. The heart-lung rectangle ratio was 24 per cent.

COMMENT

The diagnosis of mitral valve disease sometimes presents perplexing problems to both the internist and the radiologist. In the past, emphasis has been placed mainly upon changes readily identified either clinically or radiologically. Further effort toward the recognition of the earliest changes which occur in the first stages of mitral valve disease, or for that matter of any disease, is essential.

It is important for the radiologist to establish the limitations of his method of examination so that false confidence on the one hand or indifference on the other may be avoided. Only by such evaluation of radiologic examination can its true scope be established.

Bland, Jones and White (8) reported the case of a young woman twenty years old with mitral stenosis who died because of an accident. Her rheumatic infection started at the age of thirteen years, and murmurs of definite mitral and aortic disease had been present and had disappeared during three years of observation. At autopsy her heart weighed 275 gm and revealed mitral valvulitis without cardiac enlargement. The present author reported the autopsy findings of two patients with rheumatic mitral valve disease, with hearts weighing 140 and 190 gm, respectively, both of whom had minimal left atrial dilatation (5).

It is less well known that advanced mitral valve disease without left atrial dilatation has been found postmortem in patients who had otherwise considerably enlarged hearts. Gouley (9) encountered 7 such instances in a series of 61 cases of mitral stenosis. Schiassi (10) reported two patients with advanced mitral stenosis and congestive heart failure who had no left atrial dilatation but were found to have considerable cardiac enlargement, particularly of the right ventricle at post-

mortem examination Galavotti (11) reported the autopsy findings of a twenty-three-year old woman who had mitral stenosis, tricuspid stenosis and insufficiency, and slight aortic insufficiency without left atrial dilatation but with marked ventricular enlargement. No mention is made of the radiologic observations in any of these patients.

These are relatively rare occurrences but are cited as evidence that not every case of mitral valve disease, even with the highest degree of stenosis, must necessarily have a dilated left atrium. The reason for these exceptions to the rule is both obscure and challenging.

A systolic and presystolic or diastolic apical murmur is considered definitely diagnostic of mitral valve disease in the vast majority of cases. Nevertheless, similar murmurs, other than Austin Flint murmurs, have been reported in patients with normal mitral valves. These usually occur in the presence of a markedly dilated or enlarged heart. Wood and White (12) commented that diastolic murmurs might occur in certain large hearts with normal valves and thus lead to false diagnoses of mitral stenosis. Robinow and Harper (13) had four patients with acute transient hypertension and nephritis who had mid-diastolic murmurs at the apex simulating mitral stenosis which vanished as their conditions improved. Gunewardene (14) reported pronounced systolic and diastolic apical murmurs with cardiac dilatation due to severe anemia in patients with *Ankylostoma* infections.

This type of pseudo-mitral murmur may readily be distinguished from the cases reported here because in none of the latter was there cardiac enlargement or failure, and the murmurs were much more constant than those encountered in patients with simulated mitral stenosis.

The significance of mitral murmurs during rheumatic activity is often questionable, and prolonged observations may be required before an accurate estimate of the degree of valve damage can be made (15). Taussig (16) has stressed the fact that in

children changes in the size of the heart may show different sequences in the presence of similar valvular lesions, and that the valvular lesions are of lesser importance in the development of cardiac enlargement than is active rheumatic infection. With the cessation of rheumatic activity, it is not uncommon for the cardiac enlargement to recede and for the murmurs to change or disappear. The heart may then adjust itself to whatever valvular damage remains without further increase in size other than that commensurate with normal growth. Clinicians have long been aware of the fact that murmurs are in themselves of less importance than enlargement in the evaluation of cardiac status. Sir Thomas Lewis (17) pointed out that those who relied constantly on cardiac murmurs were always in difficulty when it came to prognosis and treatment, and that those who dealt most efficiently with cardiac patients laid the chief emphasis on other phenomena.

The relatively high incidence of subacute bacterial endocarditis in this group is worthy of thought. These patients were mostly young people who were in good physical condition and were suddenly afflicted with a disease hitherto considered almost uniformly fatal. The absence of cardiac enlargement obviously should not bear any weight in the diagnosis of subacute bacterial endocarditis.

SUMMARY

It is shown that loud and classical apical murmurs diagnostic of mitral valve disease may exist in the absence of cardiac enlargement or changes in the silhouette of the heart, just as it is possible for pronounced cardiac enlargement to be present with minimal and often misinterpreted murmurs. If the murmurs are characteristic, the diagnosis of mitral valve disease must be made even in the absence of any radiologic criteria. Conversely, if there is any enlargement of the heart, the conclusion that organic heart disease is present must be reached. In the diagnosis of mitral valve disease the demonstration of left atrial dilatation is the earliest radio-

logic sign This may be obtained in patients with murmurs which by all description should be considered functional On the other hand, there are many patients with classical mitral disease as indicated by pathognomonic murmurs who have no visible cardiac enlargement There is also a small group of patients with mitral stenosis who have cardiac enlargement without left atrial dilatation

It should be recognized by both the radiologist and the clinician that in mitral valve disease there may be no visible alteration in the radiographic appearance of the heart, just as murmurs may be absent or atypical

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Unilateral Paraspinal Abscess¹

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IN THE PAST several years attention has been drawn to an important anatomical landmark in the study of lesions of the thoracic spine known as the linear thoracic paraspinal shadow or posteromesial pleural line (1, 4, 5, 6). In many lesions of the thoracic spine there is found to be a fusiform shadow produced by lateral displacement of the pleural borders which aids materially in the diagnosis of spinal disease in this region. It is the purpose of this paper to draw attention to the occurrence of unilateral displacement of this line, rather than the well recognized bilateral or fusiform shadow.

ANATOMY

Careful anatomical studies by Lachman (6), Garland (5), and Brailsford (1) have demonstrated that on the left this posteromesial line is formed by the mediastinal pleural border of the left lung. In the lower portion of the thorax it lies perpendicular to the central ray on anteroposterior roentgenograms of the thorax. Normally the line lies immediately adjacent to and parallel to the lateral border of the thoracic vertebrae and medial to the shadow of the descending aorta. The aortic shadow, however, may be straight but directed slightly medially as it descends from the aortic knob in younger persons or somewhat convex in its descent in older individuals with increased tortuosity and uncoiling of the descending aorta. Lachman also demonstrated that this postero-medial pleural line sometimes lies perpendicular to the roentgen ray in the upper thorax behind the trachea both on the right and left sides. In the lower right thorax, because of the shelving characteristic of the postero-medial aspect of the lung, due to the presence of the azygos vein, the right postero-

medial pleural line is usually not seen. It may appear to be continuous with the shadow of the psoas muscle below the diaphragm.

This line is not always seen on the routine roentgenograms of the dorsal spine. It is, however, frequently present, especially in adults and particularly in those in the older age groups. In infants and children it is normally difficult to visualize, although it is seen occasionally. It is also seen frequently in anteroposterior roentgenograms of the abdomen in which the lower portion of the thoracic spine is included. On this latter view, it is rather easily confused with the shadow of the descending aorta and may at times be obscured by the aortic shadow.

ROENTGEN FINDINGS

Abscess formation has long been a well recognized finding in tuberculosis of the vertebrae and is most easily demonstrated in the thoracic spine (3, 7). Doub and Badgley describe these abscesses as usually fusiform or globular since the diaphragm acts as a restraining influence on the downward spread of pus. They also state that in cases treated in the recumbent position abscess formation is likely to occur above the spinal lesion rather than below it, because of the effect of posture. Sgalitzer (8) says that in 80 per cent of cases of tuberculosis of the thoracic spine there is evidence of cold abscess. These abscesses are fusiform, with the widest portion at the level of the bone focus. Similar findings are reported by Rigler, Ude, and Hanson (7), who regard the finding of a paravertebral abscess as almost pathognomonic of tuberculosis, although rarely it may also be found in osteomyelitis. Brailsford (2) notes that the normal paravertebral shadows can be displaced in a fusiform

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manner, *i.e.* bilaterally, by many other disease processes. These include neoplasm of a vertebral body with extension or hemorrhage into the paravertebral soft tissues, pyogenic osteomyelitis of the vertebrae, the acute stage of vertebra plana, osteitis deformans, and osteochondritis of the spine in infants and adolescents. The appearance of paravertebral abscess may be simulated by rupture of a dissecting aneurysm, by localized pleural thickening, or by localized empyema.

The case reported here was unusual in that the paravertebral abscess was unilateral, being confined to the left paravertebral area and extending almost the entire length of the thoracic spine.

CASE REPORT

W. McC., a 57-year-old white male, was admitted to the Cincinnati General Hospital on Jan. 3, 1945. His illness began three months previously when he suddenly began to notice continual severe pain arising between the shoulder blades and radiating anteriorly. The pain gradually subsided for about one month and then became progressively worse until the time of admission. There were also progressive weakness and numbness of the lower extremities, and during the week before admission the patient was unable to walk. A cough, productive of some yellow sputum, had been noticed since the onset of the present illness.

On physical examination the patient appeared chronically ill, complaining of pain in the upper back with any type of motion. Examination of the chest showed it to be emphysematous, with a normal percussion note and a few post-tussive râles over the bases. The heart and abdomen were normal. The lower extremities showed a considerable degree of muscular atrophy especially in the feet and lower legs with slight muscle tenderness. There was muscular weakness of both legs, more pronounced on the left. The patient was able to flex both knees slightly and to move the toes. On moving the legs there was a mass reflex with defecation. There was hypesthesia below T-6 and absence of pain below T-11. At T-4 and T-5 a tender point was present in the mid line. The upper deep reflexes were normal bilaterally. Abdominal reflexes were unobtainable. The Babinski sign was equivocal bilaterally, occasionally positive on the right. There was sustained ankle clonus bilaterally.

Blood, urine, and stool examinations gave normal findings. Sputum examination was negative for tubercle bacilli. Lumbar puncture two days after admission was traumatic and manometric studies were normal. On the sixteenth hospital day the



Fig 1 Anteroposterior Bucky roentgenogram of the thoracic spine (Jan. 4, 1945) showing the widened left paraspinal shadow (lower arrow) extending along the entire left side of the spine. The aortic knob and descending aorta lie to the left of this shadow and are of lessened density (upper arrow). There is slight collapse of the body of the fifth thoracic vertebra.

spinal fluid was slightly cloudy and yellow with 6 white cells, 4,980 red cells, Pandy reaction++. On the twenty-fifth hospital day a lumbar puncture showed an initial pressure of 100 with clear slightly yellow fluid, no clot, no cells, Pandy reaction++++. Jugular compression raised the spinal fluid pressure to 175 mm H₂O with a slow fall to 150 mm H₂O. Abdominal compression caused a rise to 200 mm H₂O with a prompt fall to 100 mm H₂O.

A teleroentgenogram of the chest revealed old pleural thickening on the left lateral chest wall. Miliary nodules were scattered diffusely throughout both lung fields, with superimposed congestive changes. Roentgenograms of the thoracic spine revealed old healed rib fractures of the eighth, ninth, and tenth left ribs in the posterior axillary line. There was collapse of the body of T-5 and narrowing of the adjacent intervertebral spaces. The left paravertebral shadow was definitely widened along the entire thoracic spine. The lower thoracic spine and upper lumbar spine showed marked osteoarthritic changes, with bony ankylosis involving the ligaments in the dorsolumbar area. The findings were thought to be due to tuberculous spondylitis of T-5 with unilateral left paraspinal abscess and miliary spread to the lungs. Repeat roentgen examination one month after admission showed no changes. (See Figs. 1, 2 and 3.)

Because of the evidence of spinal cord compres-



Fig 2 Lateral roentgenogram of the thoracic spine (Jan 12 1945) showing the partial collapse of the fifth thoracic vertebra with narrowing of the interspaces above and below (arrow)

sion, a laminectomy of T-4, 5, and 6 was done on the eleventh hospital day. The operative site was extremely vascular, and in the remaining portion of the laminae and the spinous processes small cystic areas were seen, filled with reddish granulation tissue. The epidural space was explored but no appreciable granulation tissue was encountered. The dura was somewhat reddened and injected but there was no definite compression from without. There was, however, a very definite fullness of the cord at the interspace between D-4 and D-5 and at this level there was compression of the cord by the prolapsed fifth lamina. Subsequent microscopic examination of the excised bone taken from the removed laminae showed diffuse miliary tuberculosis. The soft tissue biopsy material showed only small areas of granulation tissue.

Since the spinal cord obstruction was not relieved by the laminectomy, a left costotransversectomy was done on the thirty-sixth hospital day. The sixth rib was resected for a distance of 4 cm laterally from the costovertebral joint, with removal of the transverse process. The pleura was exposed and retracted away from the under side of the rib cage. This was easily done laterally, but on approaching the mesial portion at about the level of the transverse process, the pleura became densely adherent to the under

portion of the transverse process and vertebral body. The resection at this point was very slow, when it was completed, a fluctuant mass lying anteriorly was exposed and entered with an immediate escape of about 10 cc of thin grayish fluid containing tiny white flecks. The opening in the abscess was enlarged, and a moderate amount of frankly caseous material was evacuated with a sucker. Several loculated collections of similar material were found, and at least three distinct pockets were identified. The cavity was lined with thick, grayish ragged,



Fig 3 Postero-anterior teleroentgenogram of the chest (Feb 8 1945) showing the miliary infiltrate scattered diffusely throughout both lung fields. The widened paraspinal shadow can be seen behind the cardiac silhouette.

frable granulation tissue. There was erosion of the under surfaces of the adjacent ribs with destruction of the periosteum. Aortic pulsations were well defined.

The postoperative course was gradually downhill, with fever rising daily to 100-101° F. On the sixteenth postoperative day the operative wound broke down and discharged much pus. Multiple decubitus ulcers developed, and the patient became paraplegic. He died in peripheral vascular collapse on the forty-seventh hospital day. No autopsy was performed.

COMMENT

The case described again emphasizes the importance of the linear thoracic paraspinal shadow. Previous published reports have shown that abscess formation is

usually bilateral and fusiform in appearance. As far as can be ascertained, this is the first case reported of unilateral paraspinal abscess. This finding is important both to the surgeon and orthopedist, especially for localization of such effusions for operation and for more accurate diagnosis. In the future it is hoped that smaller effusions will be sought far earlier in tuberculosis of the thoracic spine and also in neoplastic and other inflammatory disease in this location.

SUMMARY

1 The normal anatomy of the linear thoracic paraspinal shadow is reviewed.

2 A case of tuberculosis of the thoracic spine is presented in which the paraspinal abscess was unilateral, presenting only on the left side, instead of being bilateral and fusiform.

3 The recognition of early left unilateral abscess formation, not previously

described, should facilitate the earlier diagnosis of disease of the thoracic spine.

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Fig 2 Lateral roentgenogram of the thoracic spine (Jan 12 1945) showing the partial collapse of the fifth thoracic vertebra with narrowing of the interspaces above and below (arrow)

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The postoperative course was gradually downhill, with fever rising daily to 100-101° F. On the sixteenth postoperative day the operative wound broke down and discharged much pus. Multiple decubitus ulcers developed and the patient became paraplegic. He died in peripheral vascular collapse on the forty-seventh hospital day. No autopsy was performed.

COMMENT

The case described again emphasizes the importance of the linear thoracic paraspinal shadow. Previous published reports have shown that abscess formation is

worth the additional time and film required

The routine described may, if necessary, be supplemented with a postero-anterior projection (patient supine) with the neck held in hyperflexion so that the mid-frontal area, about one inch above the hair line, is resting against the table top. This position is particularly good for the demonstration of the temporomandibular joint, the condyles, the condylar neck, and the ramus, as well as the zygomatic arch. It is important, when taking this view, that the degree of flexion is such that a vertical line dropped through the mastoid tip comes to lie cephalad to a vertical line dropped through the horizontal plane of the temporomandibular articulation, otherwise the mastoid tip will obscure the joint. In this view of fractures of the condylar neck, the pulling action of the pterygoid muscle upon the upper smaller fragment medially is well demonstrated.

For wider exposure of the cuspid-bicuspid area a film may be taken as described for the lateral view except that the sagittal plane of the skull is rotated 15 or 20 degrees toward the table and the central ray emerges through the bicuspid area. This view serves to "open" the angle between the symphysis menti and the anterior half of the body, thus decreasing the disturbing curve effect in this zone. Intra-oral films were seldom used in this group, although their value in more accurately following the course of confusing fracture lines is unquestioned.

Serial studies are of inestimable value in determining progress, particularly with reference to sequestration and infection, change in alignment of fragments and, later, evidences of union or non-union, as well as the state of progress of bone grafts.

Needless to say, a good working knowledge of the anatomy revealed by the above routine views is essential. The cervical spine, styloid process, hyoid bone, base of the tongue, and the various levels of the air-filled pharynx all offer difficulties to the uninitiated and at times even to the expert. Fracture lines know no law of distribu-

tion, and in no bone is this more true than in the mandible. It is quite necessary, therefore, that the central ray pass squarely through the fracture line if erroneous interpretation is to be avoided. It is not uncommon to see two apparently separate and distinct fracture lines with an island of bone between them. If the upper and lower portions of each line appear to converge, the likelihood of a single fracture must be considered. Here stereoscopy or an intra-oral film is of great help.

General Observations In this series of gunshot fractures of the mandible, few if any fractures of the condylar neck were encountered. These are more common in civilian life and are usually due to indirect violence, such as a blow on the opposite side of the jaw. The smaller upper fragment is usually displaced medially, but where the condylar head is actually dislocated, a tear of the articular capsule may be inferred. Fracture lines running into a tooth socket should be reported, as the oral surgeon almost invariably insists upon removal of the tooth to avoid subsequent infection incidental to a devitalized tooth. Infection will almost always follow if this crack in the armor is not removed to provide wide open drainage.

Since the majority of fractures in this series were produced by high-velocity missiles, the extent of bone loss was considerable, whole sections of the mandible being literally shot away. Mandibles struck by a partly spent projectile showed considerable comminution and less bone loss.

It is worthy of note that in fractures of the maxilla any displacement is due to the actual force of the blow. Here a displacement or evidence of separation at the suture lines furnishes the clue to the presence of a fracture. In fractures of the mandible, the plane of the fracture line and the direction of the muscle pull on the fragments are two important factors determining the extent of displacement. If the direction of the muscle pull is opposite that of the plane of the fracture line, displacement will be negligible or non-existent. If the direction of pull is along the lines of the fracture plane,

Observations on Gunshot Fractures of the Mandible¹

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THE PURPOSE OF this paper is to analyze from a radiographic point of view over 200 fractures of the mandible, considering mode of demonstration, type and location, associated bone loss, foreign bodies, infection, and facial bone injury. The patients were soldiers, and the vast majority of the fractures were caused by high-velocity projectiles. Very few were of the crush type, so that direct trauma was the exciting cause in almost every instance.

Technic of Demonstration As in many cases there were associated wounds of the neck muscles, with cumbersome external fixation devices and dressings, positioning for radiography was often difficult for the patient and tedious for the technician. It was therefore necessary to evolve some simple speedy method of securing satisfactory films. The fact that the plastic and dental teams working on these cases felt that the radiography entailed should be taken over by their departments placed an added burden of proof on the x-ray department. After some preliminary studies, the following routine plan was adopted.

The conventional radiographic table with Potter-Bucky diaphragm was placed in the vertical position, and the patient was seated on a stool so that his shoulders were at right angles to the table with one shoulder resting lightly against it (Fig 1). The patient faced straight ahead so that the sagittal plane of the head was parallel to the table. He then was instructed to incline his head until the parietal eminence also rested lightly against the table. This is a comfortable, easy position to assume, and the angle of inclination thus formed by the tilted head is approximately 30 degrees from the vertical. The chin was held slightly thrust forward, and the mouth kept slightly open, so that teeth were not in contact. The central ray was directed at

right angles to the table and emerged at the level of the first molar of the side being examined. Bucky films were thus obtained in stereo, with the shift in the vertical direction. The patient was then instructed to turn around on the stool and face the opposite direction, when the above procedure was repeated and two more films were

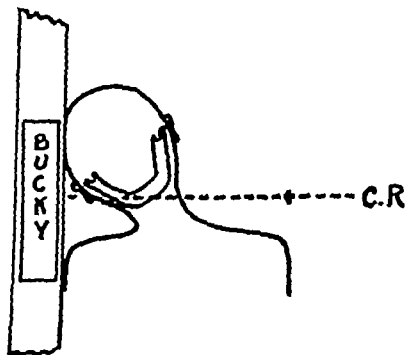


Fig 1 Position of patient for routine radiography

taken in stereo. A final set of stereo films was then made with the patient seated on the stool and facing the table squarely, the knees widespread, the chin thrust forward touching the table top, the tip of the nose about one inch away from the table top, the mouth again slightly open if possible. The central ray was directed at right angles to the table and emerged at the upper lip.

This routine examination furnished a right and left lateral and a postero-anterior view, all in stereo. The open-mouth method was found of value in following and separating the contours of the teeth in the maxilla and mandible, as well as the contours of these bones themselves, when the films were placed in the stereoscopic viewing box. The writer is not generally addicted to stereoscopy but is convinced that in studies of this region, where there is so much superimposition, in the presence of variously situated metallic bodies, the advantages of stereoscopic study are well

¹ Accepted for publication in April 1946

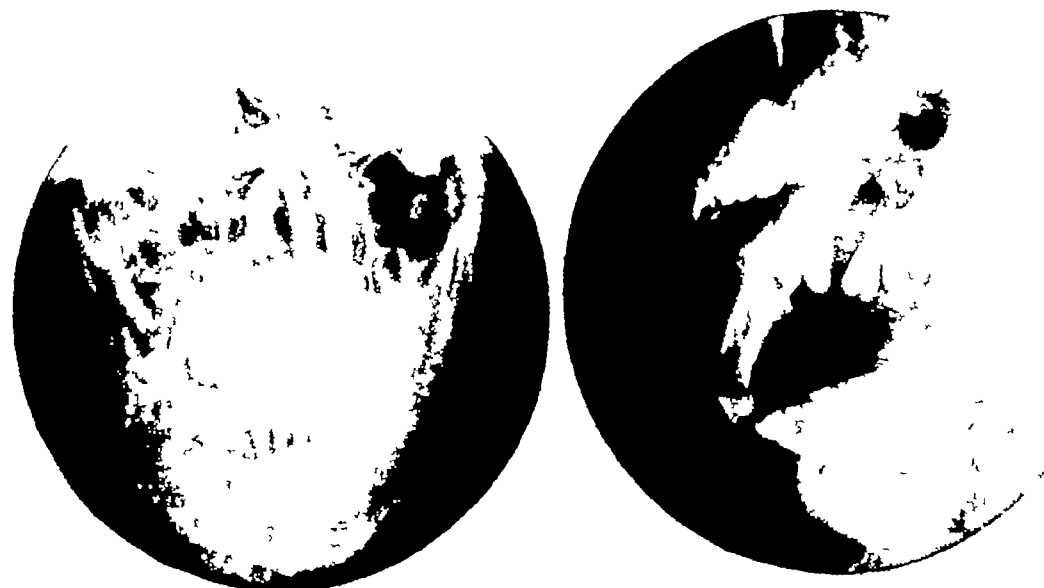


Fig 3 Multilinear fractures of the right ramus, angle, PB, and AB areas. Loss of osseous substance one plus in angle area. Metallic foreign bodies within and posterior to the angle area

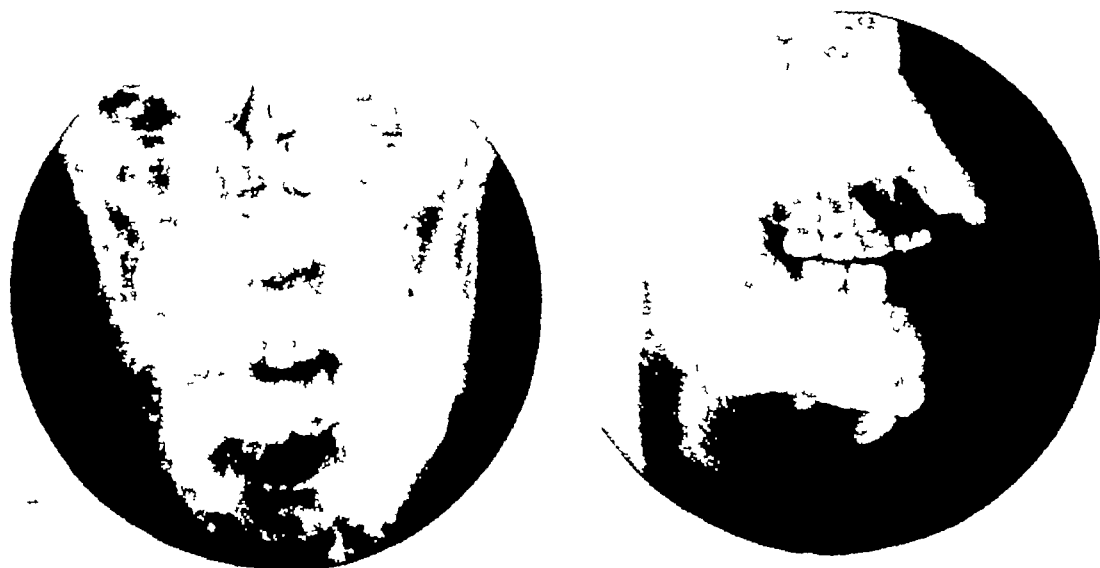


Fig 4 Complete loss of right half of mandible except for superior segment of ramus. Loss of the AB portion of left side of mandible plus multiple metallic foreign bodies in soft tissues of the right side

knowing the exact area referred to, the same general division can be made of an edentulous mandible, remembering the position of the mental foramen with reference to the 2d bicuspid. The predominant site for fracture in this series appeared to be the AB area, with the SM area second, and

the PB area third. Angle and ramus fractures were last in order of frequency, as noted in Table I.

Bone Loss The complication of bone loss was a frequent and serious one, prolonging treatment through the necessity of eventual bone grafting. These grafts, incidentally,

TABLE I TYPE AND LOCATION OF FRACTURE

Plane and type of fracture	
Vertical	12
Oblique	24
Horizontal	12
Comminuted	172
Location	
Symphysis menti (SM)	
Anterior body (AB)	56
Left	
Right	92
Posterior body (PB)	84
Left	
Right	44
Angle	40
Left	
Right	12
Ramus	18
Left	
Right	12

NOTE: Multiplicity of type and location of fractures in any one case accounts for totals in excess of the number of cases in the series. The essential value of this table is merely to indicate the marked frequency of comminuted fractures and to denote the sites of predilection in the group studied.

displacement will be extreme. In the presence of extensive bilateral comminution and loss of bone substance, the ability to manage the movements of the tongue is seriously impaired. Should subsequent films indicate widening of the fracture line, imperfect immobilization or early infection may be suspected.

Avascular dead bone or sequestration is demonstrable later in the mandible than in long bone infections. The mandible apparently does not undergo demineralization so rapidly nor so extensively as do the long bones, so that relative differences in density, usually seen in osteoporotic bone about an avascular bone island, are not readily demonstrable until quite late.

Infection. Osteomyelitis of the mandible was not a common complication in this series. Indeed, the radiographic evidence of infection was extremely low in spite of extensive injury and inevitable mouth infection. Removal of involved teeth, mouth hygiene, and active co-operation on the part of the dentist and the plastic surgeon in the way of planned treatment kept this complication at a minimum.

Non-union of the main fragments is demonstrable by the usual smooth eburnated appearance of the bone edges. With respect to mandible fractures it is axiomatic

that clinical union precedes radiographic union by many months.

Types and Location. Fractures of the mandible due to gunshot wounds, as indicated by this series (Table I), are for the most part comminuted. For the purpose of classification as to location, the mandible is arbitrarily divided, as illustrated in Figure 2. All fractures in the symphysis menti area and laterally up to a vertical line

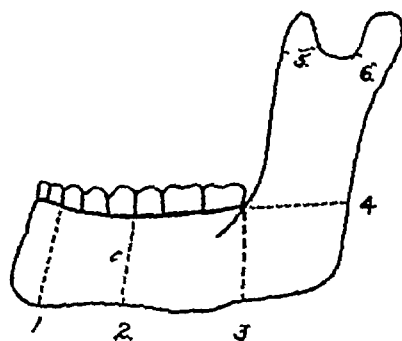


Fig 2 Arbitrary divisions of the mandible for location of fractures. Fractures to the left of 1 are classified as SM, those between 1 and 2 as AB, those between 2 and 3 as PB, between 3 and 4 as angle fractures, above 4 as ramus fractures.

dropped through the lateral borders of the lateral incisors were designated as SM fractures. This includes the area spanned by four teeth, the two central and two lateral incisors. A second vertical line was drawn between the 2d bicuspid and the 1st molar. All fractures between these two lines were called anterior body or AB fractures. A third vertical line was dropped from the retromolar area and all fractures between this and the preceding line were called posterior body or PB fractures. A more or less horizontal line also beginning in the retromolar area and extending posteriorly to emerge at right angles to the inferior ramus was then drawn. All fractures between the last two lines were called angle fractures. Fractures above the last line were ramus fractures except for those through the condylar neck and coronoid process, which were so designated. While there is nothing particularly ingenious about this arbitrary division, it is simpler to speak of an AB, an SM, or a PB fracture,

in 1 case there were fractures of the left orbit and the frontal bone (outer plate) Six benign cysts of the mandible were incidental findings

Conclusions The above more or less scattered observations with respect to gunshot fractures of the mandible are by no means original The writer does feel, however, that for adequate visualization of the mandible and facial bones, the method of routine study with supplemental stereoscopy offers distinct advantages over conventional views This is particularly true where the patient presents extensive neck

injuries rendering positioning difficult We would like to add the general observation that one cannot take too many views, often an extra film taken in a bizarre position gives valuable information

In closing, the writer takes the opportunity to express his sincere admiration for the excellent results attained by dental and plastic teams, who not only restored to normal, or passably normal, the faces of these soldiers, but also did much for the restoration of their morale

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Fig 5 Extensively comminuted fracture of the angle and ramus with horizontal and vertical fractures in the AB and PB areas. General alignment well preserved in spite of severity of fracture. Bone loss two plus. The hyoid bone is seen running through the angle area.

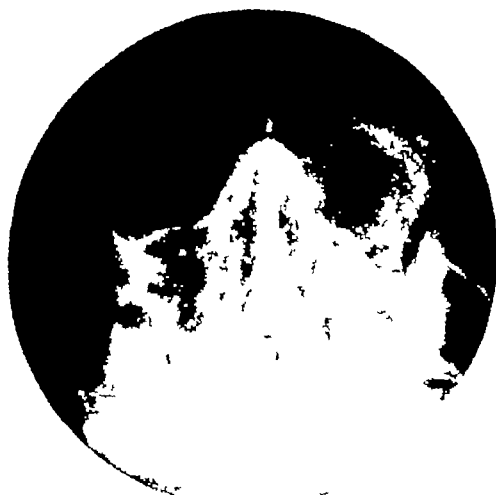


Fig 6 Waters-Waldron view of facial bones revealing multiple fractures of left malar bone, its orbital and zygomatic processes and through the infraorbital ridge. Malar bone *in toto* displaced downwards disrupting contours of left antrum. Fracture through left AB area.

were usually of the autogenous type (from the crest of the ilium), although a bone bank was available and frequently utilized. Of the 200 cases, 88 showed bone loss incidental to trauma, and in more than half of

these the loss was extensive, being classified as 3 plus and 4 plus. The comminuted fractures of the body were the most common offenders in this respect. Although it was the rule to remove all bone islands or fragments completely separated from the mother bone, some accidentally left behind proved to be adequate foci around which osteoblastic activity later took place and were therefore of help in effecting eventual union.

Foreign Bodies Metallic foreign bodies were present in 48 cases, or approximately 25 per cent of the total. Originally, this number was undoubtedly higher, for in many of the cases debridement had been done overseas, so that by the time the patients were seen in maxillo-facial and plastic centers in this country only a few residual foreign bodies remained.

Associated Facial Bone Injuries The association of facial bone injuries with fractures of the mandible was quite frequent; there were 76 such cases in this series. Of the associated injuries, 72 involved the malar bone unilaterally or bilaterally. In 3 cases the zygomatic arch as well as the malar bone was fractured, and

in 1 case there were fractures of the left orbit and the frontal bone (outer plate) Six benign cysts of the mandible were incidental findings

Conclusions The above more or less scattered observations with respect to gunshot fractures of the mandible are by no means original The writer does feel, however, that for adequate visualization of the mandible and facial bones, the method of routine study with supplemental stereoscopy offers distinct advantages over conventional views This is particularly true where the patient presents extensive neck

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An Addition to the Technic of Simple Breast Roentgenography¹

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ANALYSIS OF THE published work on roentgenography of the breast (excluding artificial contrast methods) prompts us to present our technic, which has helped us to improve the diagnostic quality of our films. A method very like ours is described in Ehrlich's recent paper, of which acknowledgment is made.

1) The posterior axillary line on the affected side is pressed against the cassette holder and the opposite shoulder is swung about 60 or 70° toward the tube so that the breast may be viewed from the tube in full profile, without other tissue superimposed. Thus, the central ray traverses the base of the breast from sternum to mid-axilla in

TABLE I TECHNIQS OF BREAST ROENTGENOGRAPHY

Author	Ma	Seconds	Distance (in.)	Kv p	Other Factors
Carty	100	3.0	36	30-70	Screens
Hunt and Hicken (1939)	50-150				Cardboard
	25-100		30	30-50	Grid and Screens
	10-50				Screens
Garshon Cohen and Strickler	100	0.3	36	32	Screens
Warren	70	2.5	25	50-60	Screens and Potter Bucky
Seabold	30	1.0	30		Screens
Bianchini		2.5	39	40-60	Cardboard
Ritvo, Butler, O'Neill	30	0.5-2	30	30-60	Screens and Potter Bucky
Lockwood	100	0.3-1	36	55-70	Screens and Potter Bucky
Hicken (1937)	37-62 ma sec		30	76-80	Screens Cone 0.25 mm Al filter
Paschetta	20	0.5		60	Screens
Vogel	22	4-6	22-26	43	
Ehrlich (upright and pendant)	30	1/10 1/4	42	50	Screens
Present authors	120	1/4	60	45-55	Screens 3 inch cone 0.8 mm rotating anode

The interpretation of breast films is still a difficult problem, and it may serve a good purpose if we remark here that not only must the technic of making films be the best available, but any supplementary facts pertinent to the case should be sought. A good history and a careful physical appraisal, including transillumination of the breast, will afford none too much assistance in the differentiation between benign and malignant lesions.

1. *Erect, High Breasts* (young, firm type). The patient stands erect against an upright cassette holder such as is used for chest studies. One of two positions may be used.

(A) The oblique anteroposterior (Fig

the plane of attachment to the thoracic wall. This plane of attachment is a zone of decreased density which it is important to see clearly on films. The nipple in profile at the apex of the breast may be marked with a small spot of barium paste. The patient's hand on the unaffected side draws that breast back out of the field. The arm of the affected side is abducted to 90° or 180° and perhaps rested on top of the cassette holder.

(B) The oblique postero-anterior (Fig 2). In this posture, the breast will be one to several inches farther from the film than in position "A." The error is a small one, however, and may not be detected. The position is as in "A," but with the unaf-

¹ From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in March 1946.



Fig 1 Position "A" with bending Direction of radiation anterior to posterior

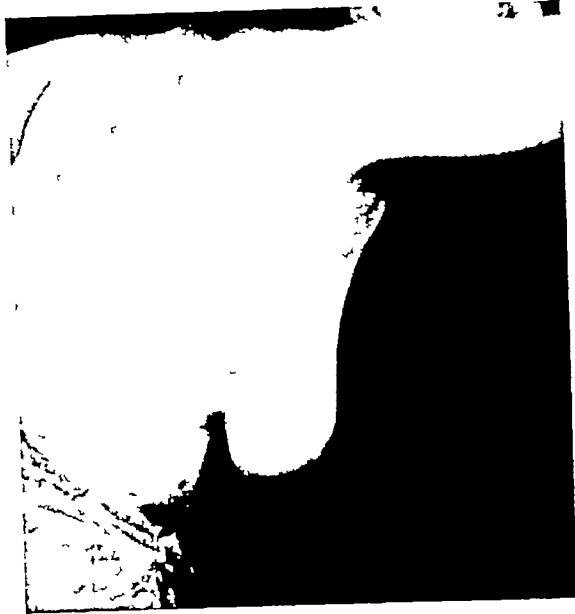


Fig 2 Position "B" with bending Direction of radiation posterior to anterior

affected anterior axillary line against the holder and the affected shoulder drawn back toward the tube

2 Pendant Breasts For pendant breasts we have found, independently, the method of Ehrlich to be most satisfactory. It is as described above, plus a lateral bending of the patient until the breast hangs free of the thorax (Figs 1 and 2)

3 Horizontal Posture for All Breasts Most examiners have used the horizontal posture for all cases, placing the patient on a table and the tube above, employing a vertical central ray. This is probably the most inconvenient position for the patient and requires padding of the breast to insure good position. Furthermore, it reduces target-film distance. However, we use it at times in order to spread the breast more flat and thin. It is of greatest value in examination of dense tissue, and is preferable for demonstrating axillary nodes.

At this point we wish to emphasize the advantage of using several exposure factors at one sitting, especially the first. As with other parts of the body, no one film yields complete data. An under-exposed film will give better diagnostic quality to the fatty periphery of the breast and to a

generally fat organ. An over-exposed film will be better for dense tissue.

Initially, a large film, perhaps 7×17 inches, is used to include the axilla. However, the other films may better be 8×10 inches or 10×12 inches, since a cone is to be used if maximum sharpness is desired and economy practised.

We agree with others in advising serial study of a breast and examination of the normal breast for comparison. Also, a record of the stage of the menstrual cycle is necessary, so that this important variant may not give rise to confusion. One examination should be made midway between menstrual periods to secure a resting-stage comparison.

Measurement of the patient has not been used rigidly for estimating exposure factors. Judgment of the size and texture of the breast is probably the best method of controlling a single variable such as kilovoltage. A large fat organ often will require less than a small firm one. The pendant posture demands 3 to 5 kv p less than the erect, since the breast grows narrower when hanging. The horizontal position at 46 inches distance requires one-half the time of and 3 to 8 kv p less than the erect

at 60 inches Basic factors for the erect posture are

Target-film distance	60 inches
Screens	Par speed double
Cone	3 X 12 inch cylinder
Ma	120
Seconds	1/4
Kv p	45 to 55
Anode	0.8 mm rotating

Filter and Potter-Bucky diaphragm are not used

DISCUSSION

A method of simple roentgenography of the breast is presented which, we believe, is technically improved, complete, and convenient. The erect or erect-pendant posture is used, with added study in the horizontal position when necessary. Very little special equipment is needed (at most a cotton pad). Several exposures of the affected breast are made initially or serially in order to enhance diagnostic accuracy. Since so many breast studies have shown unsharpness and distortion, we advocate a long target-film distance, small cone, smallest possible anode, and an exposure time short enough to eliminate the effect of cardiac or generalized movements.

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Cholecystography A Comparative Study of Oral and Intravenous Contrast Substances¹

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Pasadena, Calif.

FOR OVER TWENTY years cholecystography by means of the intravenous administration of sodium tetraiodophenolphthalein has been accepted as the most accurate method of gallbladder examination. One rarely questions the fact that gallbladder function is impaired when that organ cannot be visualized by this means. As Moore (9) points out, intravenous cholecystography is superior in that a known quantity of dye is given under known conditions.

It seems plausible that evaluation of studies with an oral contrast substance by comparison with intravenous cholecystography would be of more value than an appraisal based solely on pathological confirmation. This is true because factors unconcerned with cholecystography enter into selection of patients for surgery. In any group of persons with poorly functioning gallbladders, as determined by cholecystography, only a portion will be clinically suitable for surgical treatment. It may be assumed that most errors will be in the group not operated upon. Such errors will appear in no table of statistics based upon pathological confirmation. On the other hand, evaluation on the basis of clinical diagnosis alone is subjective and is of questionable value.

A new drug known commercially as Priodax (beta-[3, 5-diortho-4-hydroxyphenyl] alpha phenyl propionic acid) has been introduced as an oral contrast substance for gallbladder visualization. Priodax has achieved prompt and apparently widespread acceptance, and numerous reports (1, 4, 5, 6, 8, 10, 11, 14, 15, 16) have confirmed its superiority to sodium tetraiodophenolphthalein administered orally. The following advantages have been re-

ported: (1) the incidence and severity of vomiting, diarrhea, and other side effects is decreased, (2) the shadow-producing qualities are better, (3) confusing shadows due to contrast medium in the colon are decreased.

The object of this study is to compare examination with Priodax and intravenous cholecystography, where each has been used in the same patient. Particular attention will be paid to discrepancies in the results, and a probable cause for such discrepancies will be discussed.

TECHNICS EMPLOYED

Whatever contrast medium is used, meticulous roentgen technic is imperative. Careful positioning of the patient is essential. The films must be of uniform quality and without movement. The radiographic equipment should be capable of allowing a very short exposure.

Proper preparation for the oral test is important, the influence of a preliminary diet will be discussed later. Six Priodax tablets (0.5 gm. each) are swallowed whole during the course of a fat-free evening meal. The patient may drink water during the evening but is allowed nothing by mouth after midnight. He reports to the x-ray department the next morning, fasting, and at fifteen hours the first film is exposed. The radiologist sees the film, interviews the patient, and outlines subsequent procedures. Films in various positions, at a later hour, or after a fatty meal, may be requested. Since the patient is fasting, a barium meal study may be started without delay if further gallbladder examination is not necessary.

Sodium tetraiodophenolphthalein is administered intravenously under the direct

¹ From the Departments of Radiology of the Alton Memorial Hospital and the St. Joseph Hospital, Alton, Ill.
Accepted for publication in June 1946.

at 60 inches Basic factors for the erect posture are

Target-film distance	60 inches
Screens	Par speed double
Cone	3 X 12 inch cylinder
Ma	120
Seconds	1/8
Kv p	45 to 55
Anode	0.8 mm rotating

Filter and Potter-Bucky diaphragm are not used

DISCUSSION

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method produced a gallbladder shadow of normal density

Four additional cases are similar in nature. The patients were examined after being on a greatly restricted diet. Priodax cholecystography resulted in faint shadows, whereas the intravenous method produced good to normal visualization of the gallbladder.

DISCUSSION

Only those cases in which Priodax cholecystography indicated gallbladder disease will be discussed. These cases may be divided into two groups. In 22 cases the gallbladder was not visualized, and in 18 cases the density of the gallbladder shadow was distinctly less than normal.

Of the 22 cases not visualized with Priodax, none was visualized by the intravenous method. This is strong evidence that Priodax cholecystography is trustworthy when the diagnosis of gallbladder disease is based on non-visualization.

When the gallbladder was faintly visualized, however, the diagnosis was not dependable. Eleven of the 18 cases were confirmed by the intravenous method, whereas 7 showed normal concentration when the examination was repeated with the intravenous dye. Since these cases comprised 12 per cent of the entire series, critical evaluation of the contrast substance should depend on a study of such cases.

If Priodax cholecystography is to achieve accuracy comparable to that of the intravenous method, the problem of evaluating the faint shadow must be solved. The faint shadow cannot be considered normal, for in 7 cases of this series it was proved microscopically to be due to significant organic disease. In other cases these faint shadows obviously did *not* indicate organic gallbladder disease.

When 12 per cent of the results are questionable, the value of the examination is limited. It is not sufficient to state that diagnosis must depend also on clinical findings, we all accept the dictum that cholecystography is not a test for cholecystectomy. The real problem is to eliminate, or

at least recognize, those cases in which a faint gallbladder shadow is not significant.

The Faint Shadow The diagnosis of gallbladder disease based on faintness of the shadow is an established procedure when the intravenous method is used. In this series, 7 such cases were operated on and the opinion confirmed, and 2 more are presumably confirmed by the roentgen demonstration of biliary calculi.

Scott and Moore (13) summarized the findings in 1,355 intravenous cholecystograms. In 12.9 per cent of this number gallbladder disease was diagnosed because of faintness of the shadow. It was felt that this diagnosis was of definite clinical value. A comparison of operative findings and pathological reports revealed an accuracy of 92.7 per cent. No mention is made of preliminary diet.

Scott and Moore point out that such diagnosis hinges largely on the ability and experience of the roentgenologist, and that the personal equation comes into play. The physician must be familiar with changes resulting from improper roentgen exposure and from variations in the thickness of the patient. They point out that the success of a diagnosis based on the degree of impaired function demands that a constant and known quantity of the medium reach the blood stream, and this can be achieved only by the intravenous method. Otherwise, it is impossible to compare the density of one gallbladder shadow with another. They have no confidence in the radiologic diagnosis of gallbladder disease because of faintness of the shadow obtained by oral cholecystography, since the amount and rate of absorption of the dye from the alimentary canal are unknown.

Influence of the Preliminary Diet The 7 cases in which there was a pronounced discrepancy between Priodax and intravenous cholecystography have one common factor. In each, the patient had eaten no fat food, or no food at all, prior to examination. It is probable that the gallbladder was full of thick concentrated bile, so that fresh dye-laden bile could not be admitted.

The limitations of cholecystography in

supervision of the radiologist, 35 gm of the drug, dissolved and properly filtered and sterilized, is diluted in 500 cc of normal saline and injected during a period of approximately forty-five minutes. The dilution and rate of injection are of prime importance. Serious reactions are rare when these principles are observed, whereas they are common if the drug is not diluted or is given rapidly. Films are commonly exposed at four, eight, and twenty-four hours.

DATA

In 1944, 150 patients were examined with Priodax. One hundred and four examinations resulted in normal gallbladder shadows and are not given further consideration in this study. The other 46 patients have also been examined with intravenous sodium tetraiodophenolphthalate. In 39 instances the two examinations were in perfect accord, while in 7 cases there was definite disagreement.

Similar Results The gallbladder was not visualized by either method in 22 patients. Of these, 13 have undergone cholecystectomy with pathological confirmation of gallbladder disease in all. Twelve of the 13 had multiple calculi, only 4 of which were radiopaque.

In 11 additional patients, faint gallbladder shadows were produced by each method, 5 had filling defects typical of calculi. Seven of these patients have been operated upon, again with definite pathological confirmation of the roentgen findings (4 with calculi, 3 without).

Six more cases showed fairly good concentration by the oral method. While the density of the shadow was somewhat increased by the intravenous method in all of these cases, they probably should have been considered normal on the basis of the oral examination alone, and are not discussed here.

Dissimilar Results In 7 cases the two examinations were in definite disagreement. The Priodax shadows were faint, indicating poor concentration of the dye, the faintness of the shadow, if obtained by

intravenous cholecystography, would be considered a definite indication of gall bladder disease. Yet when these 7 cases were re-examined by the intravenous method, fairly good to normal density of the gallbladder shadow resulted. Details of several of these cases will be presented.

Reactions Reactions were recorded only when the patient felt they were definitely due to the drug. The approximate incidence with Priodax was: nausea 13 per cent, headache 11 per cent, diarrhea 11 per cent, dysuria 4 per cent, and vomiting 2 per cent. It is of special interest to note that neither vomiting nor diarrhea interfered with absorption of the drug, all such patients exhibited satisfactory concentration of the dye.

CASE REPORTS

CASE I M M, a white female aged forty three, had suffered several attacks of right upper quadrant and general abdominal pain, chiefly cramping in character associated with nausea, vomiting, and diarrhea. Following one such episode, cholecystography was done. The vomiting and diarrhea had ceased, but the patient had had nothing but a liquid fat-free diet for several days preceding the examination. Oral cholecystography with Priodax resulted in very faint shadows. Re-examination was done by the intravenous method at four hours; the shadow was somewhat denser than with Priodax, while at eight hours it approached normal density. The roentgen diagnosis was decreased function of the gallbladder, probably secondary to the general condition of the patient.

A gastro-intestinal study was essentially normal and the final diagnosis was food allergy. Five weeks later, after the patient had been on a normal diet so far as fats were concerned, the Priodax examination was repeated and the gallbladder shadow was of normal density.

CASE II A R, a white male aged forty, had been on a completely fat free diet for suspected chronic cholecystitis. Because of recent gastro-intestinal symptoms he had had only liquids just prior to examination. The results with both Priodax and intravenous cholecystography were identical with those in Case I. Three weeks later, after the patient had been on a normal diet, Priodax examination was repeated and normal gallbladder shadows were obtained.

CASE III B L, an obese female aged twenty one, presented vague gastro-intestinal symptoms. She was on a liquid diet several days prior to examination. Faint visualization of the gallbladder was obtained with Priodax, whereas the intravenous

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one of the largest sources of error in oral cholecystography

CONCLUSIONS

1 Priodax is a satisfactory oral drug for contrast visualization of the gallbladder

2 Non-visualization of the gallbladder after administration of Priodax is dependable evidence of organic gallbladder disease

3 Faint, subnormal density of the gallbladder shadow may be due to organic pathology or may be secondary to physiological stasis of the gallbladder

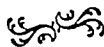
4 A high-fat diet prior to cholecystography will increase the accuracy of the examination

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the presence of certain extrabiliary organic disease are well known and always stressed. It seems logical that physiological conditions could interfere equally with the function of the organ. Is it not certain that a fat-free diet—so often advised in cholecystitis—will result in stagnation and almost complete cessation of function? The patient who is on a fat-free diet, and even more so the patient who has taken no food at all, probably has a gallbladder full of thick concentrated bile. Into such a gallbladder the fresh dye-laden bile cannot enter in normal quantity, most of the fresh bile passes on into the duodenum.

This is not a new concept. Curl's (2, 3) studies on supposedly normal medical students offer convincing evidence that the preliminary diet influences gallbladder function as portrayed by oral cholecystography. His experiments indicate that a fat diet preceding cholecystography will give more accurate results.

In 1935 Jenkinson (7) advocated that all patients with non-visualization be re-examined after a month, during which time a diet rich in fats should be given. In a case of non-visualization by the intravenous method in which cholecystectomy was performed, Whitaker (17) found, a normal gallbladder filled with thick concentrated bile. Robinson (12) recommends the routine administration of a fat meal three hours prior to ingestion of the oral dye.

Nevertheless, such a procedure has not been widely accepted or emphasized. Of the papers on Priodax so far published, only those by Vaughan and Eichwald (15) and by Unfug (14) suggest a fat meal prior to examination. Usually the subject is dismissed with the statement that regular diet is allowed until the drug is administered.

It appears that the preliminary diet affects oral cholecystography more than it does intravenous cholecystography. This is logical, since concentration of dye in the hepatic bile is probably higher, over a shorter period, with the intravenous method. Even so, gallbladder stasis incident to a fat-free diet may affect intravenous chole-

cystography, resulting in delayed and decreased function as judged by shadow density. It is logical to assume that accuracy of diagnosis based on faintness of the shadow obtained by intravenous cholecystography might be improved were the examination preceded by a high-fat diet.

Further studies in evaluation of the faint gallbladder shadow as found in Priodax cholecystography are necessary. It is in this group of cases that the accuracy of oral cholecystography can be improved. This study suggests (1) that faint shadow not due to organic gallbladder disease will be less frequent if a fat meal prior to examination is routine, (2) in the evaluation of a faint shadow in any particular case, the preliminary diet of the patient should be considered, (3) that, if the diagnosis is in doubt, re-examination after a period of fat diet, or with intravenous dye, is desirable.

SUMMARY

The advantages of Priodax over oral sodium tetraiodophenolphthalein are confirmed in a series of 150 examinations.

Forty patients in whom Priodax cholecystography indicated decreased function were also examined with intravenous sodium tetraiodophenolphthalein.

The Priodax findings were confirmed in 33 cases, and of these 20 were further confirmed by pathological study.

In 22 cases the gallbladder was not visualized either by Priodax or by intravenous sodium tetraiodophenolphthalein. The gallbladder was faintly visualized by Priodax in 18 instances, but in only 11 of these cases was a similar result obtained by the intravenous examination.

Seven cases which were poorly visualized with Priodax showed normal concentration when re-examined by the intravenous method. The common factor in these 7 cases was the absence of fat in the diet for several days preceding examination.

This study emphasizes the importance of a high-fat diet to empty the gallbladder prior to examination. It appears that the adoption of such a routine would eliminate

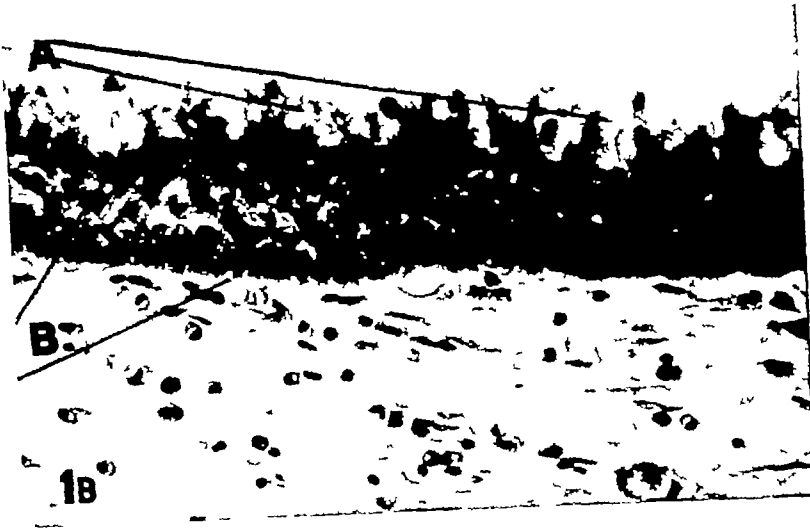


Fig 1B Beginning squamous metaplasia of columnar cells (A), squamous cells (B) Hematoxylin eosin $\times 500$

struction of the epithelium at this stage

Microscopic examination about one month after completion of the course of irradiation shows regeneration of the epithelium, the familiar normal structure of the mucous membrane of the larynx is never exhibited. It is transformed into a highly differentiated, epidermoid epithelium showing various degrees of cornification. The basal-cell layer is often somewhat irregular and contains a few normal and occasional pathological mitoses (Fig 1A). These changes are observed not only in places where, under physiological conditions, the larynx is covered with squamous epithelium (epiglottis, anterior portion of the arytenoid cartilage, vocal cords), but also in those areas in which normally high columnar ciliated epithelium is usually found (Fig 1B). The transformation of the simple squamous epithelium of the larynx into highly differentiated, cornifying, epidermoidal structures develops, therefore, as an indirect metaplasia following disintegration of the original epithelium.

Experimental studies on the irradiated larynx of the guinea-pig likewise reveal epidermoid metaplasia of the epithelium and of the ducts of the laryngeal glands (5,000 r tissue dose by fractionated protracted irradiation during a four-week period) (Fig 2).

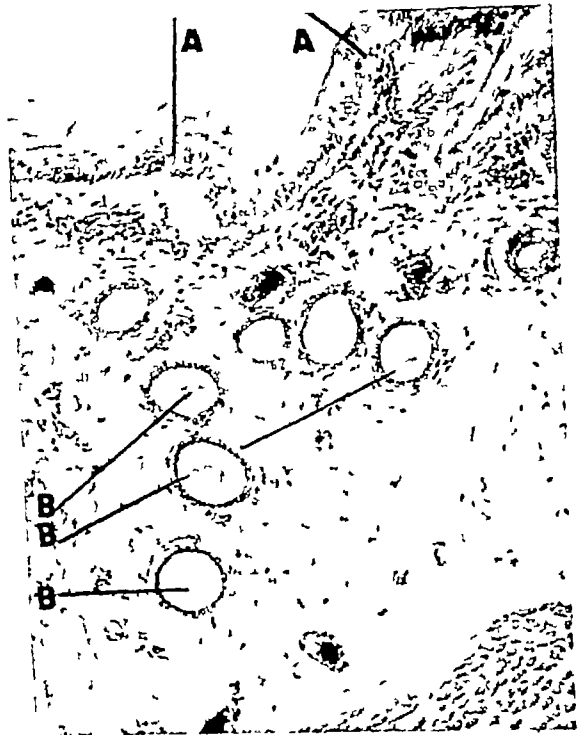


Fig 2 Larynx of guinea pig after x ray irradiation. Squamous metaplasia of epithelium (A) and of dilated ducts of laryngeal glands (B) Hematoxylin eosin $\times 185$

The thickness of the metaplastic epithelium of the larynx, which varies somewhat in normal conditions, differs widely after irradiation. The prickle-cell layer in the writer's cases was formed mostly by three to four or more layers of increasingly corni-

Late Changes in Mucous Membrane of the Irradiated Larynx

Their Radiobiological Relationship to the Subepithelial Connective Tissue and to Retrogression of Laryngeal Carcinoma Histologic Studies¹

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COUTARD (1922) was the first to describe the early fibrinous reaction to irradiation of the mucous membrane (radioepithelitis) of the oral cavity, larynx, and pharynx. He observed that the difference in radiosensitivity of the epithelium and the epidermis is about the same when protract-

selective destruction of the basal cells of the mucous membrane, the so-called epithelicide dose, is about 3,500 r, and the same effect on the epidermis is attained by about 4,500 r.

I had the opportunity of studying microscopically the mucous membranes of the



Fig 1A Epidermoid metaplasia of mucous membrane of larynx after irradiation. Note well developed prickly cells. Pathological mitosis in basal-cell layer (A), beginning cornification (B). Hematoxylin eosin. $\times 700$

tion and fractionation are employed as when other methods of irradiation are used. The epithelium of the larynx is destroyed in approximately thirteen to eighteen days. The epidermis of the neck, however, does not disintegrate before the twenty-sixth to the twenty-eighth day. The mucous membrane has regenerated approximately twenty-six days after the first irradiation, the epidermis after forty-two days. The physical dose necessary for

irradiated human larynx specimens one to ten months after protracted fractionated irradiation for carcinoma. The average tissue dose was 5,800 r. The Thoraeus filter had been used, with 220 kv and an average rate of 81 r/min. The size of the fields was 6×6 cm. Only one of the larynges was still in the stage of fibrinous reaction. All the others were in later stages. This observation has been described in an earlier paper in this series. It revealed de-

¹ From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. The third of a series of four papers accepted for publication in June 1946.



Fig 1B Beginning squamous metaplasia of columnar cells (A), squamous cells (B) Hematoxylin eosin $\times 500$

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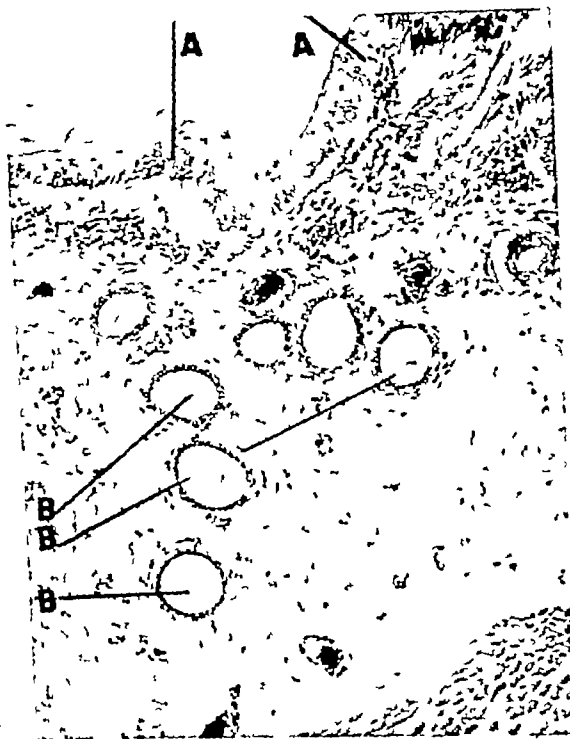


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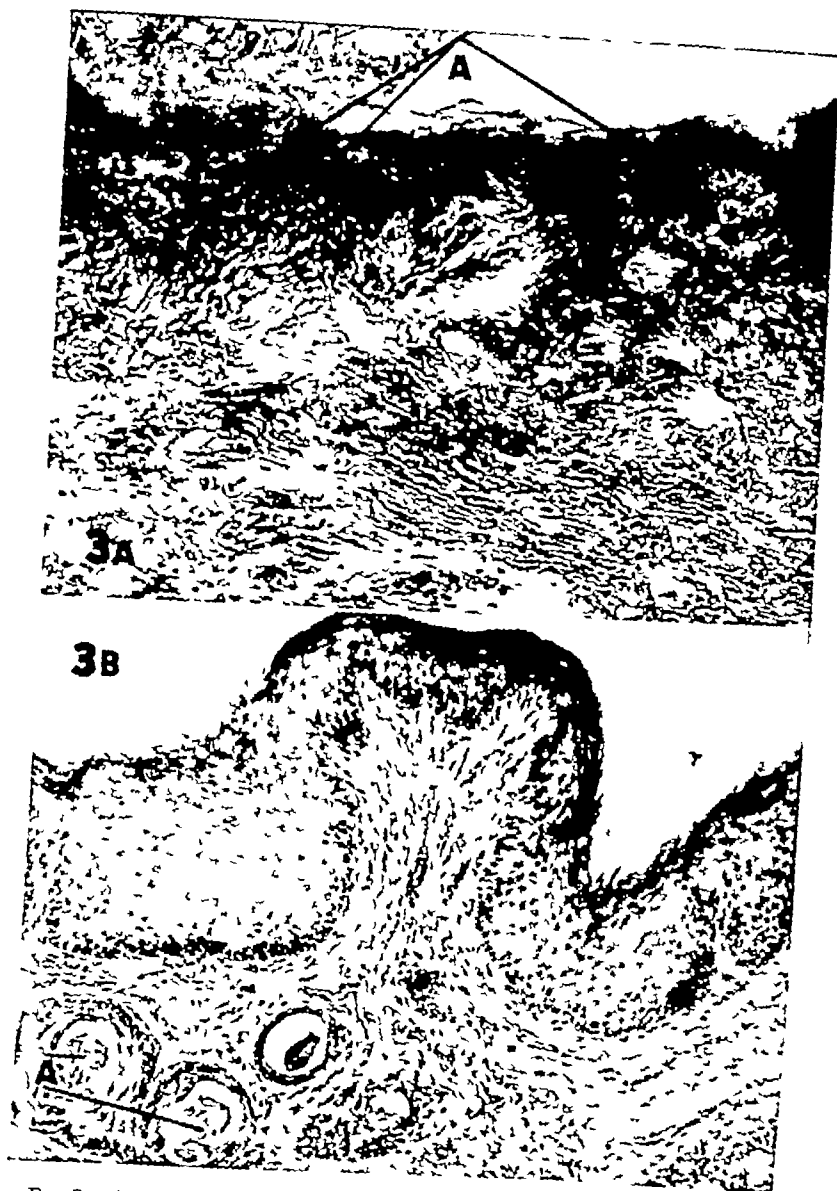


Fig 3 A Advanced atrophy of epithelium associated with hyaline sclerosis of subepithelial connective tissue. Note large amount of collagenous intercellular fibers and very few nuclei. Keratin masses (A) and few epithelial cells above connective tissue. Hematoxylin eosin $\times 250$.
 B Thick epidermoid epithelium growing above well preserved connective tissue. Note squamous metaplasia of columnar epithelium of glandular ducts (A). Hematoxylin eosin $\times 250$.

fied cells. In areas in which the subepithelial connective tissue shows advanced post-irradiation retrogressive changes (hyaline or fibrinoid degeneration, scar formation), the epithelium becomes regularly thin (two to three layers). In general, the layers of prickle cells are reduced in such conditions. Sometimes, a single layer of

basal cells and a meshwork of cornified material without cells are visible above the hyaline connective tissue. In cases receiving a large tissue dose (7,170 r) and presenting advanced hyaline degeneration of the subepithelial connective tissue, this atrophy of the epithelium is especially marked (Fig 3A).

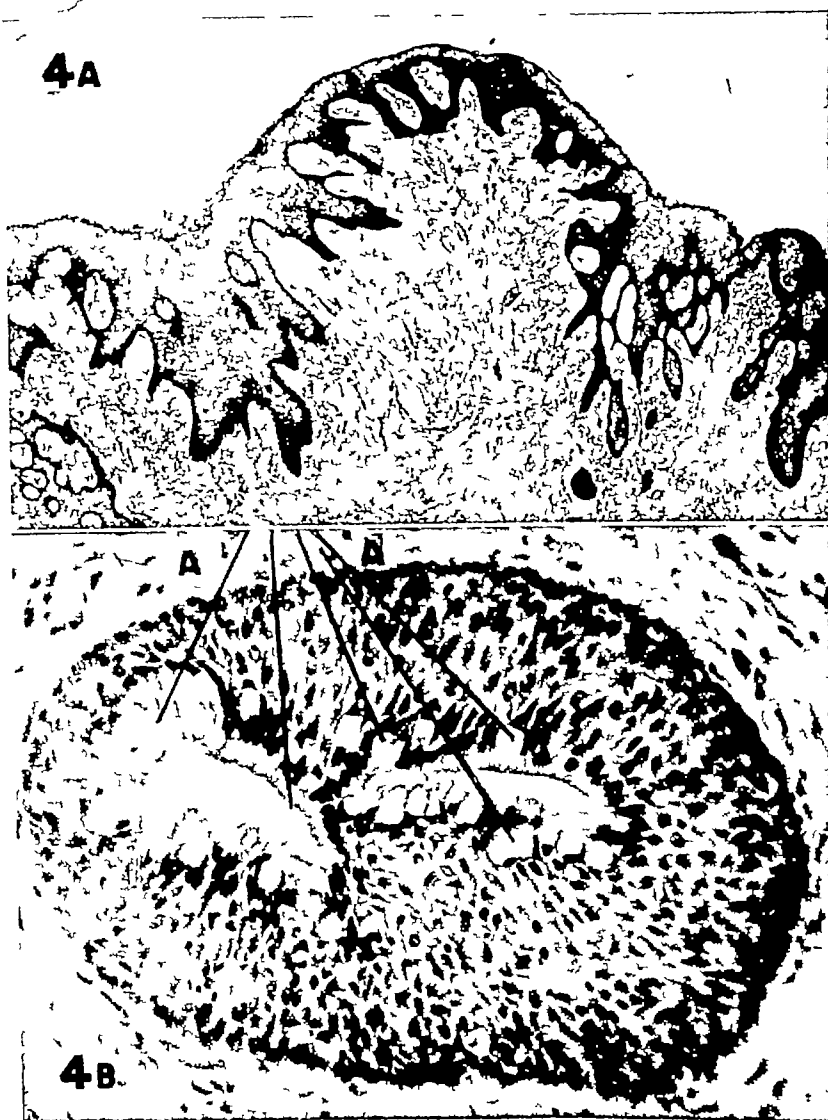


Fig 4 A Deep epithelial papillae are proliferating into well preserved connective tissue. Precancerous structure of laryngeal epithelium No signs of malignancy Hematoxylin eosin $\times 150$

B Squamous epithelial structures growing into ducts of laryngeal glands Well preserved columnar epithelial cells (A) above growing epithelial masses Hematoxylin eosin $\times 500$

Hyaline sclerosis of the connective tissue is almost regularly present in cases in which the fibrin reaction is strong, appears early, and is maintained for a long period of time. In cases in which no fibrin membrane is observed or the reaction is weak or absent. In such conditions, the epithelium is thick and the cornification negligible (Fig 3B).

Further studies of the metaplastic

squamous epithelium several months after irradiation show various changes within the epithelium, sometimes morbid, sometimes apparently physiological. Marginal ingrowth of metaplastic squamous epithelium to cover ulcerated areas, I have regarded as physiological. I have considered as pathological, variations in thickness of the epithelium, regressive and progressive changes of epithelial cells, and abnormal mitoses in the germinative layer.

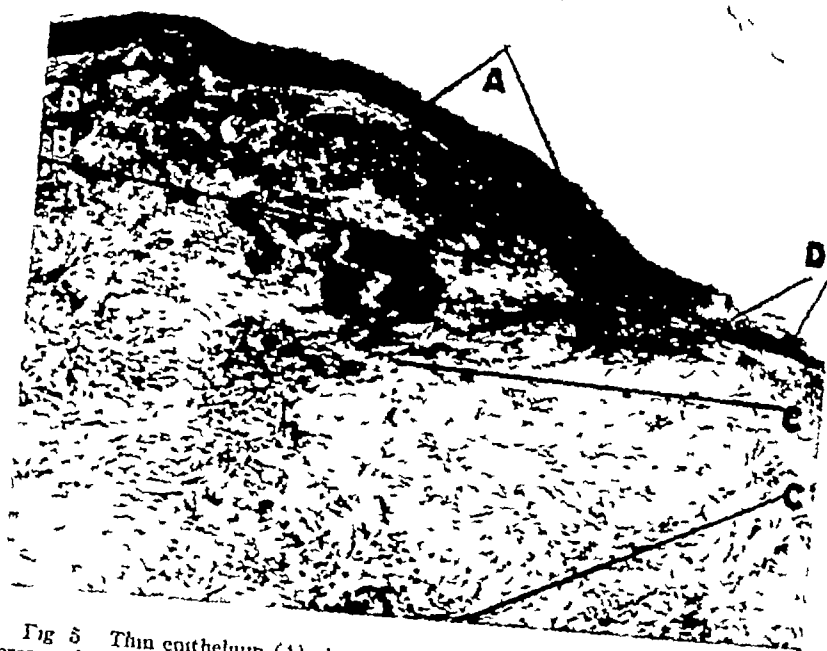


Fig 5 Thin epithelium (A) above fibroid connective tissue (B) becoming increasingly atrophic (D) covering hyaline sclerotic tissue (C) Hematoxylin eosin X250

In two cases in which recurrence of the tumor was found (tissue doses 5,380 and 4,350 r, examination five and seven months after irradiation), the epithelium was very thick, revealing deep papillae and growth of squamous structures into the ducts of the laryngeal glands (Fig 4). Giant nuclei and multinucleated cells were seen in the deep parts of the epithelium. The microscopic appearance was similar to that in known precancerous states of epithelial structures.

Most remarkable is the regular coincidence of atrophy of the epithelium with hyaline sclerotic changes in the connective tissue. This is associated with considerable thinning of the connective-tissue layers and condensation of elastic fibers. If, in the same specimen, atrophic areas of connective tissue alternate with well preserved structures, atrophy of the epithelium is found to be more or less limited to the former (Fig 5):

In two cases in which the epithelium was thin and the connective tissue atrophic,

² In this connection it seems worth while mentioning that atrophy of the connective tissue of the skin regardless of the cause, is also always followed by atrophy of the epidermis. On the other hand, primary atrophy of the epidermis is unknown.

sclerotic, with frequent areas of hyaline degeneration and obliterated blood vessels, as in scar tissue, the tumor disappeared clinically as well as microscopically. In the other cases, the epithelium was usually thick and no hyaline scar tissue was present, while the connective tissue was for the most part well preserved, or regenerated, exhibiting no sign of radiation changes. In these cases, residual or recurrent tumors have been observed.

It seems that the coincidence of atrophy of the epithelium and hyaline sclerosis of the connective tissue is not fortuitous. Both changes are directly or indirectly induced by the same biological factors. A causal connection between progressive atrophy of metaplastic mucous membrane and hyaline sclerosis of connective tissue is acceptable on the basis of microscopic findings.

These findings may be corroborated by observation of the behavior of the columnar epithelium of laryngeal glands after irradiation. These often exhibit squamous metaplasia of the epithelial linings and dilatation of the ducts. In the presence of hyaline sclerosis of the connective tissue around the glands, the metaplasia may ex-

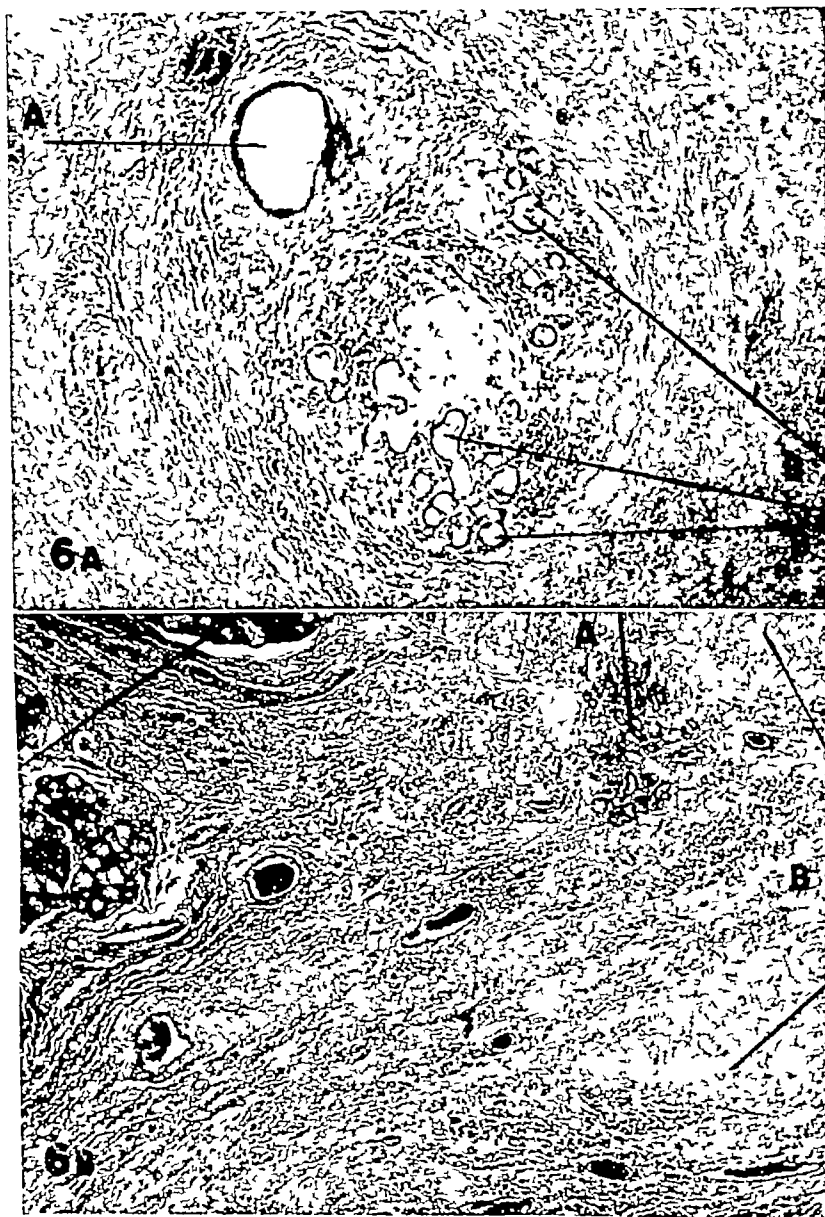


Fig 6 A Atrophy of laryngeal gland following irradiation Dilated duct (A) and dilated alveoli (B) are partly outlined by metaplastic squamous epithelium Note mucous degeneration of connective tissue and mild cellular infiltration Hematoxylin eosin $\times 70$

B Advanced atrophy of laryngeal glands (A) surrounded by hyaline sclerotic connective tissue (B) Note well preserved glands imbedded in normal appearing connective tissue (C) Hematoxylin eosin $\times 50$

tend from the ducts into the alveoli Subsequently the glands may become wholly atrophic

Occasionally the sclerosis of the connective tissue involves more or less circumscribed areas below the epithelium In such cases it may be observed that those

glands which are inside the sclerotic area are atrophic while those which are outside of it, and surrounded by well preserved connective tissue, show a nearly normal structure, despite the fact that they have been exposed to the same dose of radiation (Figs 6A and 6B)

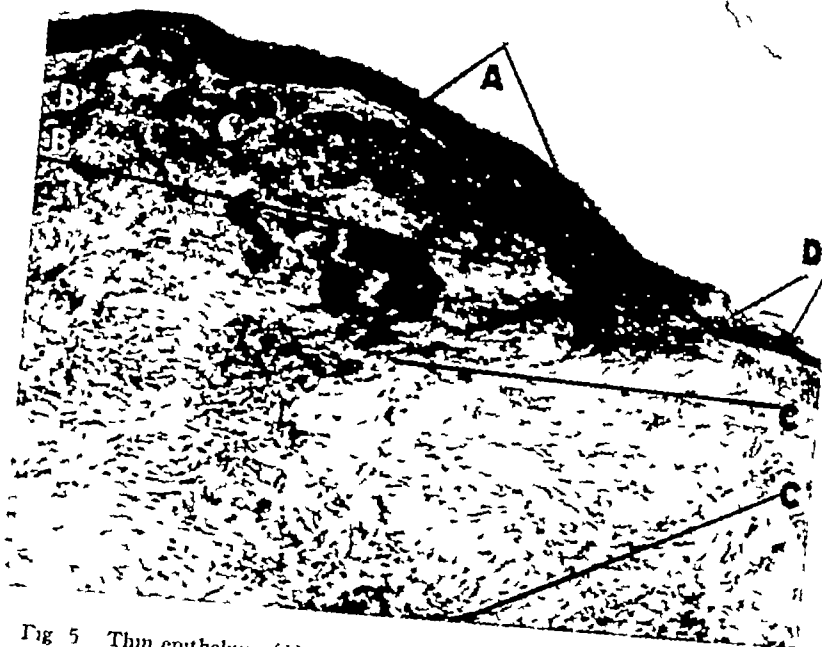


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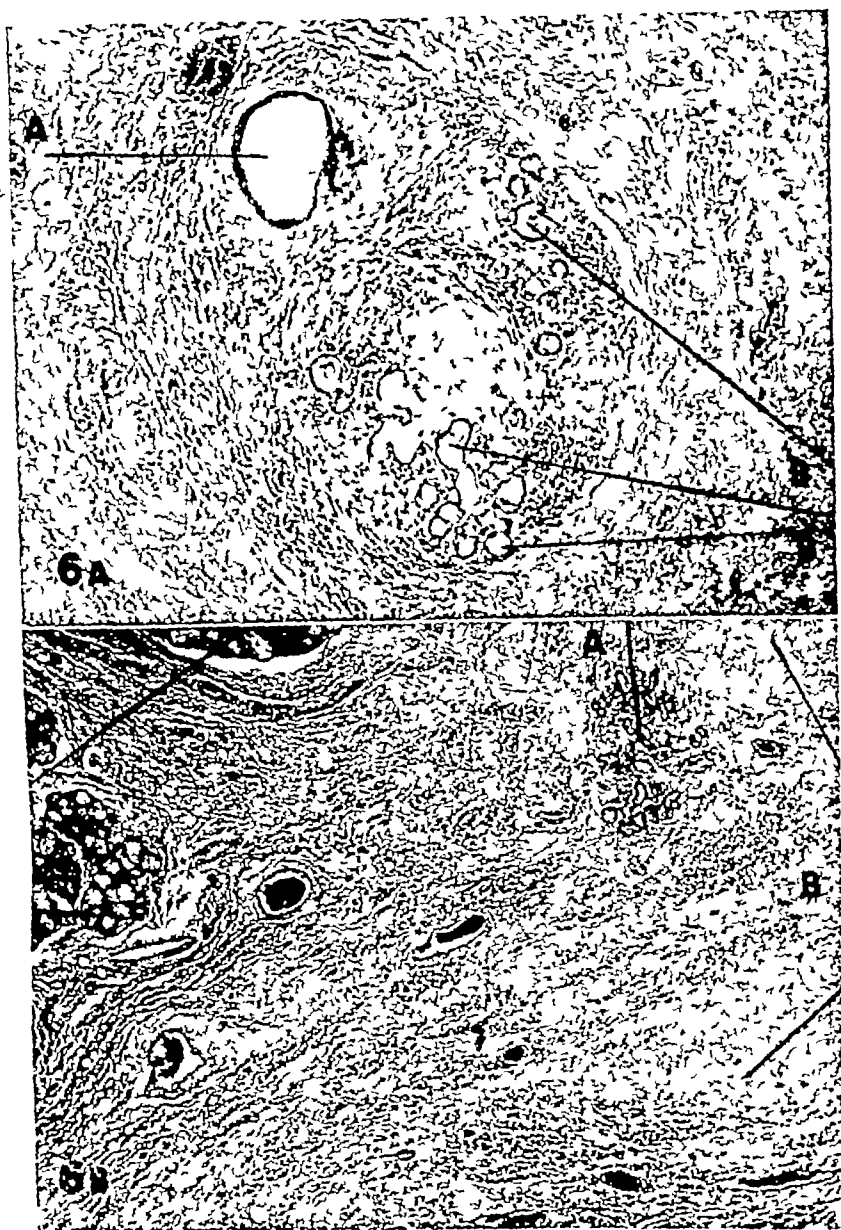


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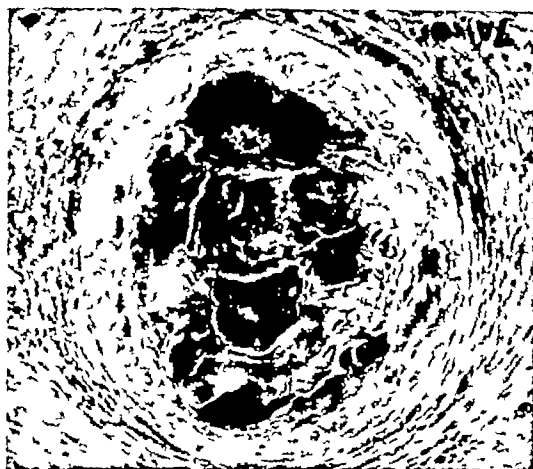


Fig 7A Amorphous keratin masses indicating non-viable residues of squamous-cell cancer surrounded by hyaline sclerotic connective tissue. Hematoxylin eosin $\times 180$

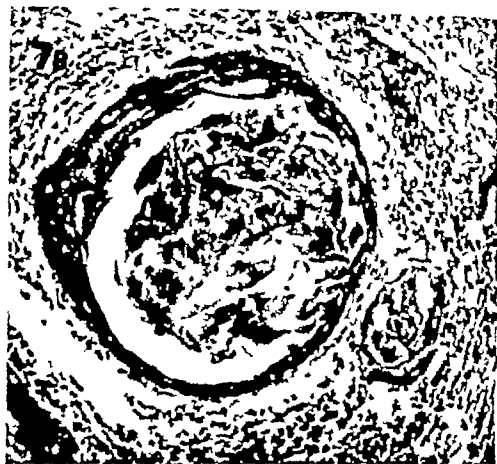


Fig 7B Residues of squamous-cell cancer with viable tumor cells surrounded by slightly infiltrated but not hyaline sclerotic connective tissue. Hematoxylin eosin $\times 180$

If this relationship is transferred to the tumor and its connective surroundings, we may state that the same conditions which are instrumental in producing atrophy of the epithelium may also cause atrophy and final disappearance of epithelial tumor tissues (Figs 7A and 7B). The interaction

between sclerosis of connective tissue and atrophy of the epithelium has already been anticipated by Coutard and by later investigators. So far as I know, however, it never has been conclusively proved and demonstrated as it appears in the present series of examinations.

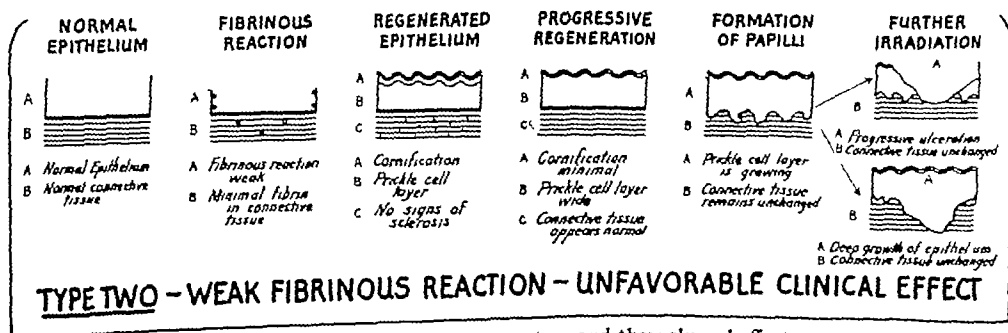
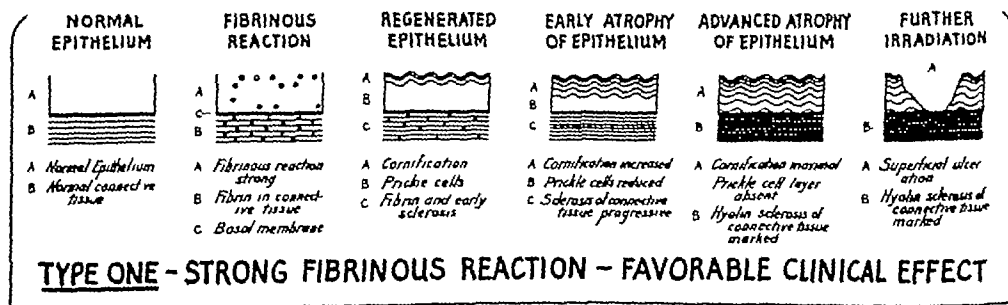


Chart 1 Types of fibrinous reaction and their clinical effect

SUMMARY

Microscopic study of the mucous membrane of the cancerous larynx after protracted fractionated irradiation reveals that the primary effect of irradiation is cell destruction. At the time fibrinous reaction occurs, the mucous membrane is entirely destroyed. Later, regeneration of epithelium takes place. The regenerated epithelial structures which often replace the columnar epithelium are also metaplastic, revealing excessive cornification. This metaplasia has also been produced by irradiation in animal experiments.

The structure of the regenerated epithelium varies according to the post-irradiation condition of the subepithelial connective tissue. In two cases out of ten the subepithelial connective tissue of the larynx was transformed into hyaline sclerotic tissue with large amounts of interstitial collagen, few cells, and obliteration of blood vessels. In these two cases, the epithelium was markedly atrophic and the tumor of the larynx had disappeared. Clinically, strong fibrin reaction was ob-

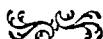
served. In two other cases displaying large residual or recurrent tumors, the superficial epithelium exhibited definite tendencies toward atypical growth after irradiation. The connective tissues were remarkably well preserved in these cases and clinically no fibrin reaction was observed.

These studies indicate that, while the primary epithelial radiation effects are fading out, the changing generations of metaplastic epithelium adapt the growth and differentiation properties of their structures to the post-irradiation condition of the subepithelial connective tissue. In cases in which the tumor has disappeared, advanced diffuse atrophy (fibrosclerosis) of the connective tissue and epithelium is observed.

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REFERENCE

- COUTARD H. Sur les délais d'apparition et d'évolution des réactions de la peau et des muqueuses de la bouche et du pharynx provoquées par les rayons X. *Compt rend Soc de biol* 86 1140-1146, 1922.



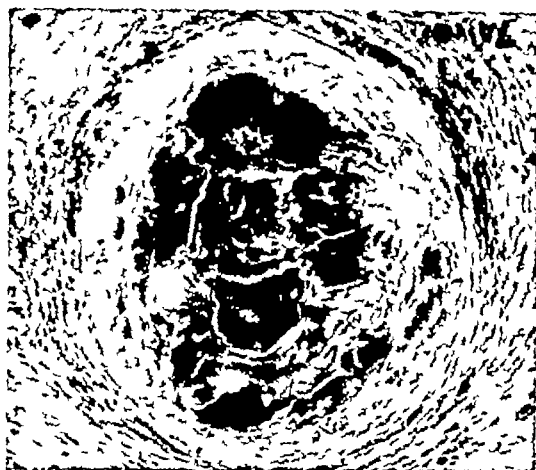


Fig 7A Amorphous keratin masses indicating non-viable residues of squamous-cell cancer surrounded by hyaline sclerotic connective tissue Hematoxylin eosin X180

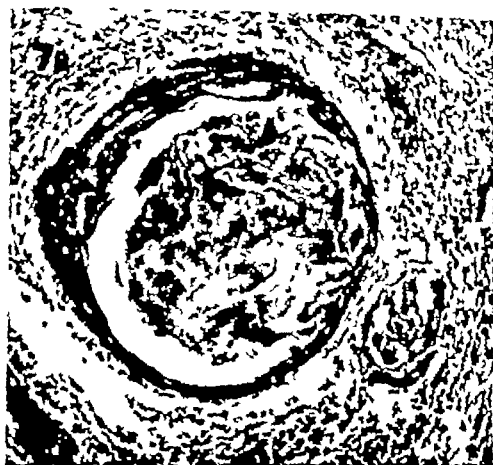


Fig 7B Residues of squamous-cell cancer with viable tumor cells surrounded by slightly infiltrated but not hyaline sclerotic connective tissue Hematoxylin eosin X180

If this relationship is transferred to the tumor and its connective surroundings, we may state that the same conditions which are instrumental in producing atrophy of the epithelium may also cause atrophy and final disappearance of epithelial tumor tissues (Figs 7A and 7B) The interaction

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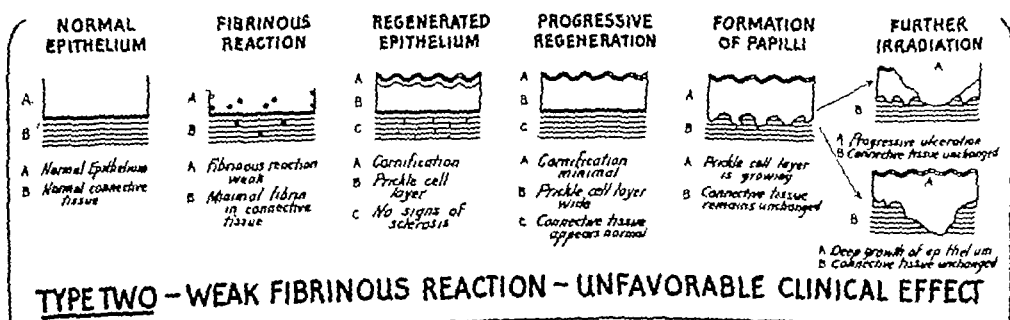
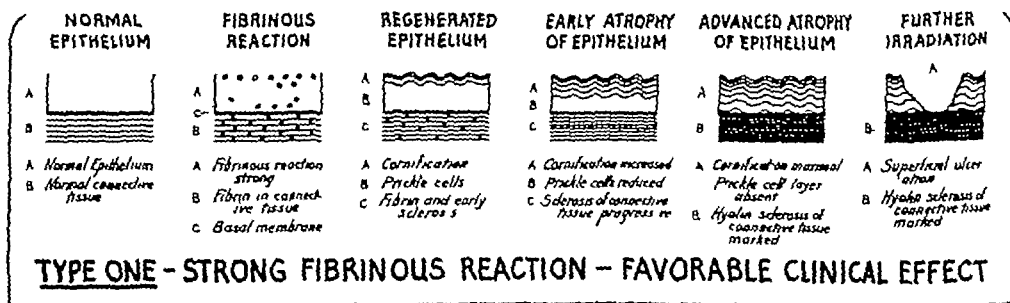


Chart 1 Types of fibrinous reaction and their clinical effect

SUMMARY

Microscopic study of the mucous membrane of the cancerous larynx after protracted fractionated irradiation reveals that the primary effect of irradiation is cell destruction. At the time fibrinous reaction occurs, the mucous membrane is entirely destroyed. Later, regeneration of epithelium takes place. The regenerated epithelial structures which often replace the columnar epithelium are also metaplastic, revealing excessive cornification. This metaplasia has also been produced by irradiation in animal experiments.

The structure of the regenerated epithelium varies according to the post-irradiation condition of the subepithelial connective tissue. In two cases out of ten the subepithelial connective tissue of the larynx was transformed into hyaline sclerotic tissue with large amounts of interstitial collagen, few cells, and obliteration of blood vessels. In these two cases, the epithelium was markedly atrophic and the tumor of the larynx had disappeared. Clinically, strong fibrin reaction was ob-

served. In two other cases displaying large residual or recurrent tumors, the superficial epithelium exhibited definite tendencies toward atypical growth after irradiation. The connective tissues were remarkably well preserved in these cases and clinically no fibrin reaction was observed.

These studies indicate that, while the primary epithelial radiation effects are fading out, the changing generations of metaplastic epithelium adapt the growth and differentiation properties of their structures to the post-irradiation condition of the subepithelial connective tissue. In cases in which the tumor has disappeared, advanced diffuse atrophy (fibrosclerosis) of the connective tissue and epithelium is observed.

2361 Clay Street
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REFERENCE

- COUTARD, H. Sur les délais d'apparition et d'évolution des réactions de la peau et des muqueuses de la bouche et du pharynx provoquées par les rayons X. *Compt rend Soc de biol* 86 1140-1146 1922



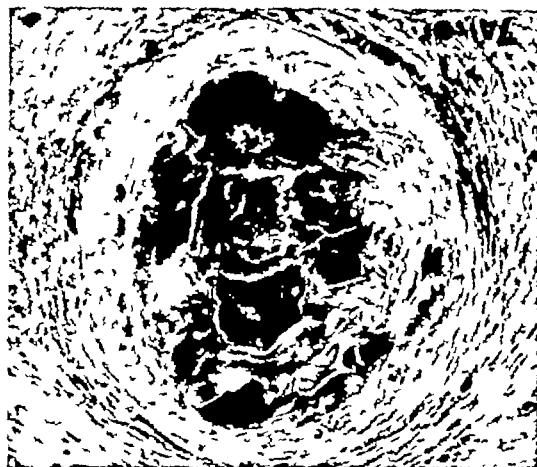


Fig 7A Amorphous keratin masses indicating non-viable residues of squamous-cell cancer surrounded by hyaline sclerotic connective tissue. Hematoxylin eosin $\times 180$

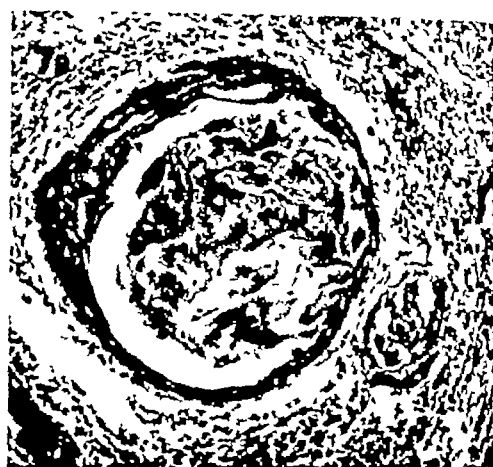


Fig 7B Residues of squamous-cell cancer with viable tumor cells surrounded by slightly infiltrated but not hyaline sclerotic connective tissue. Hematoxylin eosin $\times 180$

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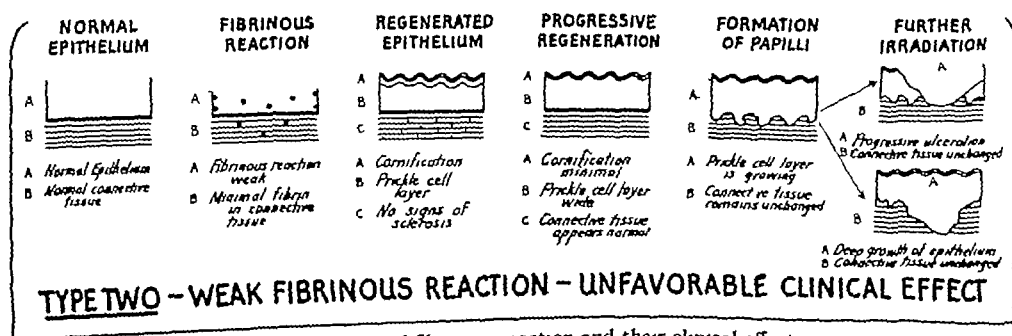
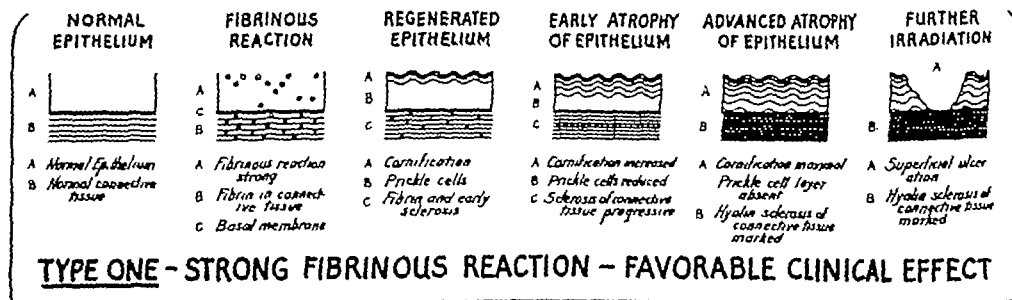


Chart 1 Types of fibrinous reaction and their clinical effect

taking a lateral as well as an antero-posterior x-ray, whenever an injury of the spine is indicated. Furthermore, he developed and read the roentgenograms immediately after he took them and made the positive statement 'Well this confirms the doctor's diagnosis. There are no bones broken.' It must therefore be assumed that the pictures were taken as a diagnostic aid and that if J— had discovered that the patient's back was broken, he would have known that fact so that further attention could have been given to the injury."

The Appellate Court concluded, therefore, that the "evidence produced at the trial amply supported the jury's verdict that J— was negligent and that such negligence was the proximate cause of damages

to the plaintiff." The judgment in favor of the plaintiff was affirmed.

The foregoing case (*Stanhope vs Los Angeles College of Chiropractic*, 128 Pac R 2d, 705) contains several important references to the duties of radiologists and physicians, in addition to the "agency" reference. The holding of physicians liable for mistaken diagnoses is a rare and unusual instance and is an indication that we who are making diagnoses must be more than ever careful to guard against mistakes. As a matter of fact, it is exceedingly doubtful if a court of last resort in any other state would be liable to render a verdict or uphold one that was based upon an error in diagnosis.

812 Marshall Field Annex
Chicago 2, Ill



Legal Liability For Error in Diagnosis

Roentgenologist and His Employer Held Liable for a Mistaken Diagnosis¹

I. S. TROSTLER, M.D.

Chicago, Ill.

"Agency is always a question of fact for the jury"

A VERDICT AGAINST a chiropractor-roentgenologist and his employer recently affirmed by the Appellate Court in California cannot but be of great interest to all radiologists.

The plaintiff, after injuring his back, was taken to the Los Angeles College of Chiropractic. After a physical examination by a chiropractor, he was informed that he had sustained a bad sprain and should have a roentgenographic examination. In an adjoining room, for \$15.00, an anteroposterior film of the lower dorsal and lumbar spine was made by another chiropractor, who declared "Well, this confirms the doctor's diagnosis. There are no bones broken."

The patient then returned to his home and, after being in bed for three days and suffering intense pain, was taken to the Los Angeles Hospital, where anteroposterior and lateral roentgenograms showed a compression fracture of the twelfth dorsal (thoracic) vertebral body.

Later, this patient brought suit against the Los Angeles College of Chiropractic and the chiropractor-radiologist and secured a judgment. From this verdict and judgment the defendants appealed to the District Court of Appeals of the Second District, Division 1 of California. In the trial, the college contended that the radiologist operating the roentgen laboratory was neither its agent nor employee at the time of the plaintiff's examination. From the evidence, however, it was shown that the x-ray department was in one of three rooms, next to the waiting room, on the ground floor of the college building, and that the x-ray apparatus was owned by the president of the college. The radiologist did the examinations for the president's

patients and taught a course in x-ray diagnosis in payment for rent, telephone, and janitor service. He collected his own fees from all other patients and conducted the x-ray laboratory as though it were his own.

The Appellate Court said "Before a recovery can be had against a principal for the alleged act of an ostensible agent, it must be shown that the third person, dealing with the agent, did so with a reasonable belief in the agent's authority, that the belief was generated by some act or neglect of the principal sought to be charged, and that the third person in relying on the agent's apparent authority, was not guilty of any negligence on his own behalf. So far as the record shows, the college did nothing to put the plaintiff on notice that the x-ray laboratory was not an integral part of the institution, and it cannot be seriously contended that the plaintiff, when he was being carried from room to room, suffering excruciating pain, should have inquired whether the individual doctors who examined him were employees of the college or were independent contractors. Agency is always a question of fact for the jury, and the trial court held that the evidence in the case was sufficient to support the jury's implied finding that J— (the radiographer) was the ostensible agent of the college.

"The college also contended that there could be no recovery against an x-ray technician unless two facts were established: negligence on the part of the technician and evidence that the pictures (*sic*) were used by the physicians in treating the plaintiff or as a diagnostic aid. The record reveals that J— (the radiologist) did not follow the generally accepted practice of

¹ Accepted for publication in June 1946

by a small group who, for example, persist stubbornly in regarding the stethoscope as an instrument of great value in the examination of the chest. Within the first year after the announcement of the discovery of the x-rays, pulmonary tuberculosis was diagnosed by roentgen examination, a method for the localization of a foreign body in the eye was devised, and the first issue of the first journal devoted to Radiology appeared. In this same year, oil-immersed tubes were invented, double-focus tubes with vacuum regulation became available commercially, the intensifying screen was described, and the use of double-coated films between two screens was suggested.

I recall these events to your memory to point both the short elapsed time and the speed with which modern Radiology has developed. When one studies the program to be presented here this week, and reflects that the events just described have occurred within the lifetime of many of us, one may begin to realize both the youthfulness and the incredible growth of our specialty. Like all of the young, Radiology is vigorous, and sometimes a little brash. Its growth, like the growth of children, has been rapid, and like them it is unusually susceptible to attacks of various afflictions. The recognition of these truisms, the suppression of the brashness, and the diagnosis and the cure of our afflictions are among the things which rest within our hands, and which will shape our future.

"As a man thinketh in his heart, so is he," said Solomon, and his wisdom is reflected by the persistence of the proverb. As a sort of corollary, one might say that a man's fellows are likely to accept him at his own valuation, provided that his conduct bears out his contention. If we are to shape our own future or, at least, have a hand in its shaping, we must resolutely examine our conduct. I fear greatly that too many of us are still glorified technicians, that too few of us are true clinicians. Very recently a radiologist said to me that he had a distaste for therapy because he disliked dealing with patients, that he

much preferred to look at films. I presume that he was totally unaware that he had expressed his distaste for the practice of medicine. When told of a radiologist who had correctly diagnosed erosion and perforation of the appendix by a fecalith, and who, after seeing the film, had inquired as to the white blood cell count, a surgeon remarked, casually, that the radiologist simply hadn't ceased being a good doctor. Isn't this the goal for all of us—to be good doctors? It is, indeed. And on such a foundation, Radiology may erect an even more imposing structure than it now possesses. But the necessity is urgent, radiologists must be clinicians. They must see patients, they must read histories, they must witness surgical procedures, and they must frequent the pathologic laboratory and the autopsy room if they are to hold their own with other clinicians. We must strive for the extinction of the "film reader", we must discourage the serving of multiple hospitals, we must deplore the virtual giving over of departments of radiology to the control of technicians while we pursue other profitable enterprises, and we must strive, vigorously, to make Radiology a true clinical specialty. Thus we may hope to survive as a free specialty, but unless we are prepared to render service superior to that which a man reasonably trained in his own field can furnish for himself, we will lose our reason for being and so our specialty will perish.

A factor which will shape the future of Radiology, and one partly within and partly outside our hands, is the role of the hospital in the medicine of the future. The origin of this problem is remote. The relationships that have developed between hospitals and radiologists were never conceived as formal and desirable plans, they simply developed without much direction from anyone. Many of you can remember the days of the Grosse Flamme coil, the Wehnelt interrupter, and the gas tube. The equipment was clumsy, undependable, and expensive. Its operation was not free from danger, and required a combination of physician, technician, electrician, and

EDITORIAL

Radiology and the Future

Presidential Address, Thirty-Second Annual Meeting
Radiological Society of North America¹

LORD BACON remarked that every man owes to the profession which nourished him some portion of his time and effort, and I suppose he meant to include in that statement the advisability of thinking sometime about one's profession. As one does so, there come to mind thoughts which concern the future of our specialty and raise questions which must have occurred to most of you many times.

What does the future hold for Radiology? Shall it continue as a free specialty, increasing in rank and dignity, or shall it be absorbed gradually into the multiple specialties to which it contributes? Shall it remain a recognized branch of the practice of medicine or shall it become submerged in the general functions of hospitals? Shall it continue to be taught as a specialty, or shall its teaching in the future be directed to those many specialists who will use it within their own fields? On the answers to these cogent questions rests the future of Radiology, and perhaps even the level of our national health, since it may well be that if medicine is deprived of the extraordinary co-ordinating skill possessed by the modern radiologist, diagnostic ability as a whole may reflect the ensuing loss.

The future is a malleable thing. It is not rigid, nor is it preformed or predetermined. It is shaped by the will of men, and its form is being determined now, by us, and by many others. We have not the entire shaping of it, however, its character may be altered by influences beyond our immediate control, and to this extent

we are helpless. But our own influence is strong, our future lies more within our hands than within the hands of others. To cry with the fatalist that what is to be will be, is weak, nor can we thus evade our stern duty to do our utmost to shape our future to that form which we desire.

Our specialty is young. It is barely fifty-one years since Roentgen read his momentous communication "Concerning a New Sort of Rays" to the Physical-Medical Society of Wurzburg, thus all unwittingly standing as a sort of combined midwife and godfather to an entirely new branch of medicine. Quite apart from the tremendous significance of Roentgen's discovery there are two astonishing events sequential to it. The first of these is the almost unimaginable impact of his announcement on both the scientific and the lay world. It is doubtful if ever before (and perhaps, even, ever again, until a stunned world heard of the destruction of Hiroshima) was scientific information so widely and so rapidly disseminated or so eagerly received as the news of Roentgen's discovery. The second amazing phenomenon is the speed with which medical use of the new rays was developed. The first roentgenogram was produced only ten days after Roentgen's first communication and was received by an awed medical world with varied reactions. Some foresaw the development of an extremely useful diagnostic method, some, represented notably by the surgeon Schonborn, warned against over-optimism, saying that the method scarcely promised to be of much, if any, value in the diagnosis of internal disorders. Dr. Schonborn is represented to this day

¹ Delivered Dec. 2, 1946, in Chicago, Ill.

by a small group who, for example, persist stubbornly in regarding the stethoscope as an instrument of great value in the examination of the chest. Within the first year after the announcement of the discovery of the x-rays, pulmonary tuberculosis was diagnosed by roentgen examination, a method for the localization of a foreign body in the eye was devised, and the first issue of the first journal devoted to Radiology appeared. In this same year, oil-immersed tubes were invented, double-focus tubes with vacuum regulation became available commercially, the intensifying screen was described, and the use of double-coated films between two screens was suggested.

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A factor which will shape the future of Radiology, and one partly within and partly outside our hands, is the role of the hospital in the medicine of the future. The origin of this problem is remote. The relationships that have developed between hospitals and radiologists were never conceived as formal and desirable plans, they simply developed without much direction from anyone. Many of you can remember the days of the Grosse Flamme coil, the Wehnelt interrupter, and the gas tube. The equipment was clumsy, undependable, and expensive. Its operation was not free from danger, and required a combination of physician, technician, electrician, and

general repair man to keep it functioning. The field of usefulness was comparatively limited, therapy was confined almost entirely to terminal cases, largely bedridden patients, and a hospital basement seemed the logical place for such activities as constituted a good deal of the practice of Radiology. Thus it began, and inasmuch as the rewards were largely spiritual, no great attention was paid to fiscal arrangements by either the hospital administration or the radiologist. Time slipped by, apparatus was constantly improved, knowledge increased vastly, and suddenly a medical specialty was found to be in bondage to boards of hospital trustees, and the hospital was discovered to be practising a branch of medicine through the medium of a paid physician.

No one is to blame for this situation, no one willed it into being, but there it is, urgently demanding solution. Simple in theory, but complex and difficult in application, that solution is simply this: hospital administrators must be brought to see clearly that their position in practising Radiology is no whit different than it would be if they practised surgery by the same device, and that they, the medical profession, and the public will all benefit if the current practices are abolished and that part of the practice of medicine called Radiology be returned to the physicians who make it their specialty. For our part, we must train our young radiologists in sound values, good practices, and the elements of medical economics.

The modern young radiologist is superbly trained. He is the professional equal of any man, his knowledge is extensive and profound. He has but one fault—he is too impatient. Unwilling, apparently, to struggle through the lean years of beginning, he demands an immediate reward for his efforts, and is commonly not too modest in his estimation of his worth. It is true that the fields of knowledge have become so vast that travel through them is long and tedious, and that more than one-third of a man's life is devoted to his progress from infancy to certification by a

specialty board. It is true that, because of this, young men are commonly encumbered with family responsibilities when at last they are ready to enter upon their careers. But, although these truths are equally applicable to the other special fields of medicine, one rarely if ever sees young surgeons or internists who harbor the faintest idea of any career other than private practice. Why, then, does our young radiologist seek a paid position in a hospital? Why does he not enter boldly into private practice as does his fellow of another specialty? One of the great social fallacies of today is the one which (euphemistically) is called "security." In the hope of reaching this mythical goal, our people are hopefully surrendering their most priceless possession—their freedom. Here, in our own field, we see the tragedy being re-enacted—hopeful of attaining at once to that desired "security," our young radiologist surrenders his professional freedom and his hope of true and permanent security to a hospital board, instead of tediously carving for himself a niche in the professional world. Read the annual report of the Professional Bureau of the American College of Radiology and observe for yourselves the sad procession of radiologists going from one job to another, moving one more step down the professional ladder as the young and vigorous come up to replace them, and reflect on the degree of security that has been obtained. Security in a profession consists in establishing oneself in a community as an independent and self-reliant professional man, and not in becoming an employee of a hospital, or of any other sort of institution.

Our future is being shaped to a considerable extent by the teachers of Radiology. Their influence on the young men they train is enormous, and justly so. But perhaps in their eagerness to inculcate the intricate science and art of Radiology, they sometimes forget their role in forming the future of their profession. To them I say: Encourage those whose lives you are shaping to face life boldly. Encourage private enterprise, hold up private practice as a

thing to be desired. Refrain from suggesting that only hospital radiology can offer a radiologist nourishment for his professional ambition. If it be true that more clinical entities will be seen in hospital practice, and that it offers a greater wealth of pathological material, then encourage the development of small groups of radiologists who may share such services, and thus you will fulfill at once your duty to your student and to your profession. The future of Radiology rests heavily in the hands of those who will practise it in future years. If they permit it to become submerged among hospital functions, if they exchange their professional birthright for a mess of pottage, then our future is dark indeed. But if they stand firm for the value and the dignity of their profession, if they are bold in their assertion of its independence, if they refuse to depart from the ranks of medicine into those of hospitalization, then we may hope for a bright and glorious future. In this much, then, the shaping of the future rests with us.

But Radiology is a department of medicine. We are physicians first and radiologists second, and our specialty rises or falls as the corporate destiny of medicine may determine. Organized medicine is a term rather loosely employed, and one that lacks the significance which it should have. Medicine is *not* well organized, but it must become so, or perish. All of us have been too busy in our work, too engrossed with the scientific aspects of our profession, and too absorbed in the care of our patients to give to organization the attention and the personal effort that it deserves. Organized medicine, so called, must become truly organized and must be truly representative of the physicians of America. We are among the physicians of America, it is our future that is at hazard, and it is our duty to work for its salvation. Let us put off, then, the garment of superior indifference, let us cease relegating to those whom we sometimes call (in a sort of superior fashion) the politicians, the duties and obligations which are so truly ours. Let us assume these with our other burdens, striv-

ing mightily that the right may prevail. If we turn coldly from this duty, if we are willing to leave the care of our destiny to those whom we are pleased to call the "politicians," let us remember that Plato said that if a man scornfully refuse his call to govern, his fate will be to be ruled by a worse one. From this foregoing, I have hoped to show how we may, perhaps, shape the future of Radiology, not only by our behavior as radiologists, but by our conduct as members of the profession of medicine.

But we are not only radiologists and physicians, we are citizens, we are Americans, and in that great capacity we have both our duty and a further opportunity to influence the future of our chosen branch of medicine. You are all well aware of the pressure for the enactment of compulsory health insurance, and of the constant struggle of the medical profession to prevent this misfortune from coming upon the people. You may well ask yourselves why there exists so persistent an effort to enact this legislation. All available evidence indicates that compulsory health insurance is a bad way to give medical care, and that in every country in which it has been established, its enactment has signaled the beginning of a lowering of health standards and a steady increase in the amount of sickness. As physicians, then—as humanitarians—we must be concerned with the possibility that compulsory health insurance may be forced upon us, and as radiologists, we must ask ourselves what the role of Radiology will be in such a system. Shall it continue to be recognized as a medical specialty? Will its practitioners be regarded as consultants? Have the proposed laws evidenced an intention so to regard us? Without hesitation, I predict that if compulsory health insurance is enacted into law, Radiology as a specialty will cease to exist.

To date, the writers of the various health insurance bills have shown no indication that they have the slightest grasp of the significance of our branch of medicine, or indeed, that they regard it or any kind of

medical specialty. Instead, they make vague references to diagnostic centers, to inclusion of radiological and laboratory services in hospitalization. In short, they make no provision whatever for the continued existence of Radiology. I need not dwell on the deterioration of medical care standards which would inevitably follow the disappearance of so essential a service as radiologic diagnosis and treatment. The treatment of our specialty in all of the health insurance bills which have thus far been written serves to point the fact that they are, in every instance, the product of non-medical minds, that they show but little grasp of the problems involved, and that their primary purpose is not to benefit the public health. On the contrary, they have been conceived by social planners, without medical advice. They follow a pattern established by the International Labor Office, which states flatly that the next step, and its goal, is the establishment of a national medical service to include all of the population, and to be under complete bureaucratic control. I have maintained in the past, and I am prepared to defend stoutly the thesis that this represents one more step toward the destruction of the American Republic and the erection of a national socialist state. It is here that all of us, in our capacities as American citizens, must defend our specialty by defending both our profession and our country.

Since the future of Radiology is bound up closely with that of medicine, and the future of medicine with that of our country, let us take orderly steps toward doing our part in the shaping of that future. We

must not content ourselves with attempting to direct the future of Radiology but, as physicians and as Americans, we must interest ourselves in the future of our profession and of our country. Let us direct both our teaching and our practice toward the preservation and the encouragement of free enterprise. Let us never cease crying that security, so called, is a dangerous delusion, that true security may be obtained only by personal effort, prudence, and sacrifice. There are those things which we can do within our own ranks, those which must be done within the corporate body of medicine, and there are those which must be done within the body politic of the nation. We must strive to serve the people well, putting service far ahead of gain. We must give to every man, without regard to his ability to pay, anything that we can give to preserve his health and life. We must so conduct our professional activities as to give the lie to those who cry that medical care can be had only by the well-to-do, and we must never cease to resist the social planner who would substitute for the magnificent civilization we have erected on this continent, the bare and meager social structure of Europe.

I repeat that the future is not predetermined or fixed. Destiny may still be altered by the will of men. The future remains malleable until that moment when it becomes history. While it remains within our power to do so, let us deal shrewd strokes, shaping our future to that form which will best serve the nation and our profession.

LOWELL S GOIN, M.D.
Los Angeles, Calif

ANNOUNCEMENTS AND BOOK REVIEWS

FOURTEENTH ANNUAL CONFERENCE TEACHERS OF CLINICAL RADIOLOGY

The Fourteenth Annual Conference of Teachers of Clinical Radiology was held in Chicago, under the auspices of the Commission on Education of the American College of Radiology, on Feb 8. The morning session was devoted to a Round Table Discussion on The Undergraduate Teaching of Radiology, in which the following participated: Dr Ross Golden, Dr Shields Warren, Dr H Dabney Kerr, Dr U V Portmann, Dr F W O'Brien, Dr B R Kirklin, and Dr L Henry Garland. The theme of the afternoon session was Postgraduate Training of Residents in Radiology. The speakers and their subjects were: Dr Wm A O'Brien, "Selection of Residents for Training in Radiology", Dr Balduin Lucke, "Relation of the Pathologist to the Teaching and Practice of Radiology", Dr Edwin F Hirsch, "What Constitutes Adequate Training for a Resident in Radiology", Dr U V Portmann, "Essential Requirements in Radiation Physics for the Resident in Radiology", Dr B R Kirklin, "What the Board of Radiology Expects of Residents in Radiology".

POSTGRADUATE COURSE ON NEOPLASTIC AND INFLAMMATORY DISEASE

The Commission on Education of the American College of Radiology, in co-operation with the Philadelphia Roentgen Ray Society, will conduct a post graduate course in the diagnosis and treatment of certain neoplastic and inflammatory diseases, in Philadelphia, March 30-April 4, 1947. The instructors will include some of the outstanding teachers in the United States. Full information may be obtained from the American College of Radiology, 20 N Wacker Drive, Chicago 6, Ill.

THE AMERICAN SOCIETY OF X-RAY TECHNICIANS

The American Society of X Ray Technicians will hold its annual convention in Buffalo, N Y, June 1-6 at the Statler Hotel. The General Chairman of the Convention Committee is Mina Kliman, R T, 41 Butler Ave Buffalo 5 N Y.

THE FOURTH INTERNATIONAL CANCER RESEARCH CONGRESS

The Fourth International Cancer Research Congress will be held in St Louis Mo Sept 2-7, 1947 with headquarters at the Hotel Jefferson. The Union Internationale contre le Cancer having accepted the invitation of the American Association for Cancer Research the Congress will be held under

the joint auspices of these two organizations, with Dr E V Cowdry, Professor of Anatomy, Washington University School of Medicine and Director of Research of the Barnard Free Skin and Cancer Hospital, St Louis, serving as President.

AMERICAN INSTITUTE OF PHYSICS

Reorganization of the American Institute of Physics and plans for a new semi-popular journal devoted to the fast-growing science and its relation to society have recently been announced. Dr Paul E Klopsteg, Director of Research of the Technological Institute, Northwestern University, is chairman of the Institute, and Dr Henry A Barton is its director. Headquarters are at 57 East 55th St, New York, N Y.

ARMY WEEK

In co-operation with the U S War Department, and at its request, announcement is made of the observance of Army Week, April 6-12, 1947.

In Memoriam

FRED YORK DURRANCE, M D

Dr Fred York Durrance, of Houston, Texas, died on Oct 20, 1946, of coronary thrombosis at the age of 53. He was born in Arcadia, Fla, in 1893 and was educated in the University of Florida and Tulane University, taking special training in roentgenology. He practised at Beaumont, Texas, for four years prior to moving to Houston in 1931. He was Chief of the Roentgenological Service at Hermann Hospital and had served in the same capacity at the Southern Pacific Hospital.

Dr Durrance was Associate Professor of Radiology at Baylor University College of Medicine and took an active part in teaching. He co-operated also in the instruction of a large intern and resident group at Hermann Hospital. He was a member of the Harris County Medical Society, the Radiological Society of North America, and Houston Academy of Medicine, a fellow of the American College of Radiology, and a diplomate of the American Board of Radiology. He worked unceasingly for the establishment of the practice of radiology in his hospital according to the tenets of the American College of Radiology and his successors will be the beneficiaries of his efforts.

Surviving Dr Durrance are his wife, Mrs Sibil R Durrance, now president of the Harris County Medical Society Auxiliary, and a son, Fred Jr.
PALMER E WIGBY, M D

RAYMOND V MAY, M D

Dr Raymond V May, of Cleveland, Ohio, for many years on the staff of St. Lukes Hospital in that city and president of the recently organized Fairhill Hospital, died Dec. 28, 1946, after an illness of about a year. Death occurred in his home on Westlake Road in Bay Village.

Dr May was graduated from Western Reserve University in 1913 and served his internship at Cleveland City Hospital. Following this, he was engaged in the general practice of medicine in New London, Ohio, for a period of five years. He became associated with his brother, Dr Robert J May, in 1920, practicing radiology in Cleveland. Dr May joined the Radiological Society of North America in 1925 and the Cleveland Radiological Society the same year. He became a diplomate of the American Board of Radiology in 1935 and a member of the American College of Radiology in 1937.

Dr May's diligence and quiet friendliness will be long remembered by all those with whom he came in contact. He was regular in his attendance at the meetings of the Radiological Society and his fellow-

ship will be greatly missed. He is survived by his wife and four children.

GEORGE L SACKETT, M D

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CONFRONTATIONS RADIO-ANATOMO-CLINIQUES. Published under the direction of M CHIRAY R A GUTMANN, and J SÉNÈQUE. Fascicule 1. A volume of 56 pages, with 98 figures. Published by Masson & Cie, Editeurs, Paris, 1946. Price 370 fr.



RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

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THE HEAD AND NECK

Importance of Air Studies in a Neurosurgical Clinic.
Gilbert Horrax Surgery 19 725-730, May 1946

Since the introduction of ventriculography and encephalography by Dandy in 1918 and 1919, these procedures have become indispensable in the differential diagnosis of intracerebral disease. Before the use of air studies of the brain from 50 to 60 per cent of brain tumors could be localized with sufficient accuracy to be found at operation. Of the remaining 40 to 50 per cent, practically all are demonstrable following the introduction of air into the ventricles. When it is realized that approximately half of all intracranial tumors found at operation are totally removable the significance of these figures is apparent.

At the Lahey Clinic (Boston), during the year ending April 30 1945, 429 cerebral air studies were done including 323 encephalograms and 106 ventriculograms. Ventriculography or the direct injection of air into the ventricles through burr openings in the skull was used in those cases in which there were indications of considerable increase of intracranial pressure, from whatever cause. This procedure was instituted to obtain information on three major points: (1) to diagnose the presence or absence of a brain tumor in patients with choked disks and other pressure symptoms but no localizing signs; (2) to localize a brain tumor when neurologic and other data gave no indication of its site; (3) to locate the site of a tumor more exactly, when some localizing evidence was already present. Cases illustrating each of these points are presented. [Points 1 and 2 appear to the abstractor to be identical.]

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The use of encephalography in post-traumatic headache was first reported by Penfield in 1927 who had 7 patients who were relieved by this procedure. During the period covered by this communication air insufflation was used on 22 patients with post-traumatic headaches. While the percentage of cures cannot yet be determined, it is the impression of the author that three out of four patients were relieved.

J E WHITELEATHER M D

Treatment of an Unusual Subdural Hydroma (External Hydrocephalus) Walter E Dandy Arch Surg 52 421-428 April 1946

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A case is reported of a two-year-old child in whom a subdural hydroma developed following a fall. Drainage and decompression had been attempted before the patient was seen by the author but did not relieve the condition. Encephalograms showed a small ventricular system pushed 6 cm. to the right and a large bed of air over the left side and between the falx and cerebrum. The old craniotomy wound was reopened and revealed a huge amount of fluid over the left hemisphere. Since the location of the tear could not be determined, the falx and adjacent cerebrum were swabbed with 3.5 per cent iodine solution to cause adhesion. After a somewhat stormy course the child recovered. He remained well six months later.

The encephalograms are reproduced and their interpretation is discussed. LEWIS G JACOBS, M D

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While this paper is written primarily from the point of view of the surgeon, it may be of interest to the radiologist as describing a new ventriculographic sign in callosal angiomata. In 3 cases of this condition, proved by ventricular needle puncture, the ventriculograms showed separation of the bodies of the lateral ventricles.

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In the past seven or eight years fibro-osteoma, a tumor-like formation usually involving the jaw or cranial bones has become known as a pathological entity. It has been described under such designations as ossifying fibroma, osteofibroma, central fibroma of the jaws etc. A number of cases previously classified as leontiasis ossea probably belong in this group. The tumor consists of a matrix of connective tissue in which clumps and spicules of bone are present. There is no cartilage and the lesion is closely connected with the normal bony structure as a localized enlargement. The authors recognize four types showing progressive maturity of the cellular elements. They note that osteoclastic changes may occur in the more mature forms. There is some difference in opinion as to the pathogenesis but the authors believe that the tumor is a malformation in growth rather than a true neoplasm.

The most frequent site is the jaws but any part of the cranium may be involved, the most usual location being the bones of the face and anterior part of the skull. The authors present in tabular form 21 cases, in one of which the tumor occurred in a rib. The incidence is higher in young persons and symptoms are chiefly

mechanical In two reported cases of long duration sarcomatous change ensued but the tumor did not resemble osteogenic sarcoma

Roentgenologically the findings are often pathognomonic but there is variation depending upon the location and microscopic type The eburnified fibro-osteoma produces a dense structureless picture In the mature but not eburnified type slender spicules can be seen in the form of whorls and garlands or irregularly arranged so that there may be a resemblance to the stippling of the rind of an orange In the less mature types the calcified structures may be so small that they do not appear on the roentgenogram Differential diagnosis includes Paget's disease osteitis fibrosa the localized sclerosis caused by meningiomas sarcomas and inflammatory processes and for the immature type adamantinoma

ELIZABETH A CLARK M D

Cephalhematoma Deformans Late Developments of Infantile Cephalhematoma A Schüller and F Morgan Surgery 19 651-660 May 1946

Five cases in which unusual sequelae of infantile cephalhematoma persisted until adult life, are reported The essential features of the condition are (1) a history dating back to infancy or childhood (a cranial injury is mentioned in 4 of the 5 cases), (2) a peculiar bulging of the forehead, more pronounced on one side, (3) a circumscribed cranial hyperostosis presenting an unusual and bizarre structure In 4 of the cases no sign or symptom of intracranial or ocular disorder was present One patient had headache and protrusion of the eyeball developing suddenly at the age of twenty years probably due to fresh hemorrhage

The roentgen appearance is described as thickening of the cranial bones up to 6 cm in one case This thickening is mainly eccentric and merges gradually into normal bone The structure of the hyperostosis is not uniform diploe lined by thin external and internal laminae prevail in the thickened calvaria eburnated hyperostosis is present in the basal area There may be osteoporosis, osteosclerosis (similar to that seen in Paget's disease) cystic cavities and bony fragments resembling sequestra The paranasal sinuses may be absent on the diseased side if present, they may be of atypical shape The pathological process is described as new bone formation under the periosteum elevated by the hematoma This new bone may disappear partly or completely It may undergo porotic sclerotic or cystic changes Fresh hemorrhage may occur

Conditions to be differentiated include osteoma chondroma sarcoma, leontiasis ossea, meningioma hyperostosis hyperostosis combined with facial nevi and angiomatosis, syphilitic hyperostosis hyperostotic type of xanthomatosis hyperostosis in neurofibromatosis (Recklinghausen) osteitis fibrosa cystica Albright's disease hyperostotic oxycephaly hypertelorismus (Greig) mucocele of the paranasal sinuses cholesteatoma of the cranial bones or of the paranasal sinuses

In none of the authors series was operation required The name cephalhematoma deformans is proposed for this condition J E WHITELEATHER M D

Hyperparathyroidism and Parathyroid Adenoma. Three New Zealand Cases. D Whyte New Zealand M J 45 98-94 April 1946

Three cases of parathyroid adenoma of varying symptomatology are presented Two lay behind the thyroid

fascia and one in the anterior mediastinum Each possessed a well marked vascular pedicle

Tumors of the jaws and eventually the skeletal changes of osteitis fibrosa cystica developed in the first patient over a period of twelve years Roentgenograms showing cystic formations in the femora and ischium with patches of thinned, irregular cortex of long bone and decalcification, and a high serum calcium were diagnostic X ray studies nine months after surgical removal of the parathyroid tumor showed marked bone repair

In the second case skeletal changes were minor and not characteristic

In the third case the first symptom was renal colic and a calculus kidney was removed. Nocturnal frequency and symptoms related to softening of the skeleton were present for the next five years Roentgenograms showed widespread localized areas of destruction in the pelvis, right upper femur, and left patella Serum calcium and phosphorus values were high Surgical exploration of the neck revealed no parathyroid tumor and a subtotal removal of the left thyroid lobe was done A biopsy of a cystic area of the tibia showed an osteoclastoma Bone changes in the pelvis and upper femora progressed culminating in a pathological fracture of the superior pubic ramus A parathyroid tumor weighing 21 gm was found at a second operation by a trans sternal approach

Radioiodine Autography in Studies of Human Goitrous Thyroid Glands C P Leblond M Been Fertman I D Puppel and George M Curtis Arch Path 41 510-515, May 1946

Radioiodine was administered orally to patients with diffuse colloid and exophthalmic goiter before subtotal thyroidectomy Subsequent autographic study of the removed glands showed that the iodine was rapidly deposited in a stable form in the colloid part of the thyroid follicle

THE CHEST

Intrapulmonary Air Pressure and Its Relation to Pulmonary Capillary Flow W Walter Wasson Am J Roentgenol 55 575-587, May 1946

The author's object in this paper is to call attention to the importance of the intrapulmonary air pressure that is the air column within the bronchi and air sacs There is a very close association between the functions of respiration and the pulmonary circulation After the initial drop in blood pressure within the pulmonary artery following the first inspiration the relation of one to four or five between the pressure within the pulmonary artery and the aorta is maintained throughout life except in certain disease conditions There is very little increase in the thickness of the right ventricular wall after birth

The pulmonary capillaries have an area of 140 square meters It must be that the capillaries can handle the supply of blood from the heart with the same ease that the air sacs handle the exchange of air in respiration With the capillaries bare in the walls of the air sacs, the support given by the air column must be very necessary to offset the action of the elastic fibers of the air sacs and the pleura On inspiration there is a lower pressure within the air sacs and air rushes in, but with this same inrush of air there must be an inflow of blood into the pulmonary capillaries from the pulmonary artery

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struction With obstructing foreign bodies and retention of secretion, there may be chills fever, and other evidences of toxicity

Wheezing may or may not be present Breath sounds may be diminished or suppressed over the affected portion of the lung while those on the opposite side may be exaggerated Tactile and vocal fremitus are diminished The percussion note may be flattened if atelectasis is developing or tympanitic if emphysema is present Inspection of the chest in a good light, with special attention to unilateral impairment of expansion and mobility is of particular importance.

In the early stages radiographs may show no departure from normal As secondary lung changes develop, the findings depend on the type, degree and site of the bronchial obstruction If a main bronchus is totally obstructed atelectasis of the involved area will follow with increased density over the entire lung and shift of the trachea and mediastinum toward the involved side The intercostal spaces will be narrow and the diaphragm may be elevated A so-called compensatory emphysema of the opposite lung may occur

If the foreign body has a ball-valve action, the primary effect will be a trapping emphysema with gradual over distention of the affected portion of the lung In such a case the trachea and mediastinum will be shifted toward the opposite side, the intercostal space will be widened and the diaphragm on the affected side will be depressed.

It is always best to obtain films at the end of inspiration and at the end of expiration Rupture of the emphysematous lung may produce a pneumothorax with typical appearance or an interstitial pulmonary emphysema may develop with a mottled appearance due to contrasting pockets of air around the vascular and bronchial radicles

The foreign body may not obstruct a main bronchus but a secondary one in which event a lobe or a portion of a lobe will be affected When a foreign body has been in place for some time secondary pulmonary pathological changes may develop such as multiple abscesses hydrothorax or pyothorax It may be necessary to use over penetrated films to delineate the primary condition in such instances

The authors feel it advisable to have a check x ray examination of the chest three days following removal of a foreign body and if no complications develop again on the seventh day

BERNARD S KALAYJIAN, M D

An Investigation into the Radiological Appearances of the Chests of Workers Engaged in the Production of Toxic Gases P H Whitaker Brit J Radiol 19 158-164 April 1946

Irritant gases produce either a primary pulmonary edema or an acute pneumonitis with pulmonary edema as a secondary and incidental manifestation Phosgene is an example of the first type and mustard gas of the second

Radiological appearances are of two types (1) an even density around the hila becoming increasingly less toward the periphery of the lung fields (2) scattered changes—consolidation and opacity—similar to those of miliary tuberculosis Between these two the author states there must be degrees of less severity with only minor changes visible in the lungs As an example he mentions a study of six persons who had been exposed to phosgene all of whom had a mild degree of dyspnea

The radiographs showed only a mild increase in the hilar density, an increase in the markings around the roots, and a slight increase in the lung reticulation These changes persisted for varying times up to fourteen days even after symptoms had disappeared

Studies were also made on workers engaged in the manufacture of gases of the mustard type Those exposed to certain chemical processes were found to have a persistent brassy cough Chest roentgenograms of men who had been coughing for three or four months showed little change from normal but in all there was a slight increase in the root markings at the lung bases In view of the constancy of this latter finding, the study was extended to 105 workmen in another mustard gas factory After six months of employment 6 examples of increased density of the hilar markings and increased striation of the basal root markings were discovered among men giving essentially normal findings before they commenced work A final examination a year after the first following some decrease in exposure showed improved radiological appearances

The author assumes from his observations that the lung changes are probably of a simple congestive type and of no serious pathological significance They tend to regress with cessation of exposure to the irritant

SYDNEY J HAWLEY M D

Significance of Roentgen Examination for Diagnosis and Differential Diagnosis of Acute Interstitial Pneumonia R Lenk Acta radiol 27 115-128 March 30 1946 (In German)

The role of roentgen examination in the diagnosis of acute interstitial pneumonia (virus pneumonia) is discussed and the great variability of the radiographic manifestations of this disease is stressed The author describes three types none of which however is considered characteristic After discussing the radiographic differential diagnosis he concludes that the combination of some of the radiographic manifestations with fever shortly after the onset of illness permits the diagnosis of acute interstitial pneumonia with a fair amount of probability F ELLINGER M D

Primary Atypical Pneumonia, Virus Type A Brief Review—Necropsy Presentation Jack C Norris Richard F McLaughlin and S Francis Williams Mil Surgeon 98 299-304 April 1946

A fatal case of atypical pneumonia is reported with necropsy findings The authors believe that trauma, such as smoke or gas irritation, or fractured limbs and ribs initiates the disease in some instances and mention the possibility that allergy may be important in this regard In the case presented the occurrence of symptoms relative to the nervous system is emphasized, with the suggestion that the pneumonia might be related to the encephalitic infections Inflammatory lesions were present in this patient's heart, a finding not previously recorded in such cases

Bronchopneumonia Following Ether Anesthesia in Obstetrics Homer C Hartzell and Edward P Minger Surg Gynec & Obst 82 427-433 April 1946

Twenty cases of bronchopneumonia which developed following obstetrical delivery with ether inhalation anesthesia were observed Clinically the pneumonia did not prove a cause of serious illness and no fatalities resulted Its chief cause was the aspiration of gastric

March 1947

When the chest wall descends and the negative pressure within the pleural space returns to -5 mm of mercury, the elastic fibers contract and squeeze out the air, creating for the moment a positive air pressure in the air sacs and bronchi. This action must also certainly squeeze the capillaries between the elastic fiber framework on the one side and the air column on the other. The result is a pressure exerted over 140 square meters of capillary surface and the flow of blood is into the veins rather than into the pulmonary artery. A repetition of this action at each inspiration and expiration creates a pumping action upon a large volume of blood, and must be quite effective. In other words, inspiration and expiration may not only pump the air in and out of the lungs but also pump the blood through the pulmonary capillaries. In atelectasis and pneumonia by compression of the capillaries but also the loss of this auxiliary to the propelling force of the heart action.

A brief summary of the literature is given and important known facts are reviewed concerning the anatomy and physiology of the air sacs and the circulation within the pulmonary capillaries.

CLARENCE E. WEAVER, M.D.

Double-Exposure Radiograms of Chest James Maxwell Lancet I 499-500 April 6, 1946

A composite roentgenogram showing the respiratory excursion has been found informative in certain chest conditions and should prove of value in the teaching of anatomy and physiology. The same film is exposed twice, on maximal expiration and inspiration, and the extent of movement of the ribs and diaphragm is clearly recorded. The exposure time is kept constant and the kilovoltage varied. (On a machine with a delicate tuning switch graduated at least in twentieths of a second an alternative technique is to maintain a standard kilovoltage and to vary the exposure.) The author's technique is similar to that described by Vickers (Brit J Radiol 18 229 July 1945). The first exposure is made on full expiration using the milliamperes seconds factor which would be used for a standard chest film but increasing the standard kilovoltage slightly ($x + 5$). The second exposure is then made on full inspiration using the same milliamperes seconds factor and lowering the kilovoltage to a corresponding extent ($x - 5$ or -10). In this way a sharp double outline of the diaphragm can be seen and the movement measured. For an accurate study of the diaphragm the tube should be centered on a level with the muscle about the plane of the 9th dorsal vertebra but when this is done it is impossible to include the chest as a whole, for the movements of the diaphragm and ribs should be complementary, it is necessary to center the tube in the usual way. The diaphragmatic movement appears to be a little less than it actually is but films taken in this way are comparable with each other and the degree of inaccuracy is relatively slight.

The "Wet Lung" in War Casualties Lyman A. Brewer III Benjamin Burbank, Paul C. Samson and Charles A. Schiff Ann Surg 123 343-362 March 1946

The problem of the wet lung i.e. the persistence of fluid in the pulmonary tree, following trauma is discussed on the basis of the authors' combined experience in the management of over 770 casualties in which the chest wound was the primary concern and of the

thoracic complications arising in over 3,000 other casualties of all types. Fluid may be present in various forms—mucus, blood, serum, etc. Two groups of factors are of importance in the development of wet lung: (1) forces leading to the production of secretions and other fluids in abnormal amounts in the respiratory tract and (2) conditions preventing adequate removal of the fluids so produced. In war casualties many conditions are present which favor both the accumulation and inadequate expulsion of fluid material from the pulmonary tree.

The recognition of the syndrome in its earlier stages should lead to vigorous treatment and may often prevent the development of graver complications. One of the most frequent findings is an almost constant "wet cough." On physical examination there are two outstanding features: dyspnea and bronchial rales. Rales may not be elicited unless auscultation is made immediately after coughing. Frequently sticky mucus attached to the tracheal or bronchial wall or the completely obstructed branch bronchus will not present the physical signs of rales. Fine crackles heard with the stethoscope over the patient's mouth on respiration is a sensitive index of moisture in the bronchial tree. In early cases the evidence of moisture heard with the stethoscope is the most important physical sign. In advanced cases diagnosis is usually simple and can be frequently made at a distance by the dyspnea and audible rales. The character of the sputum is of diagnostic significance.

In war casualties arriving at field or evacuation hospitals in shock or with wet pulmonary tree treatment must precede roentgen examination. The frequent coexistence of extensive thoracic wall pleural or intrapulmonary lesions makes the shadows due to partial or complete bronchial obstruction very difficult to interpret. In the early stages of wet lung, roentgen findings are minimal and a considerable degree of obstruction may be present without roentgenographic evidence. Roentgenograms in two planes should be taken whenever possible. When any question arises, certain instances the information gained by the taking of the intrapleural pressure readings aids in the interpretation of roentgen findings. Patchy lobular atelectasis is seen early in these cases and may be indistinguishable from shadows due to pulmonary hematoma. Later when lobular or total pulmonary atelectasis is present the collapse of these parts of the lung produces the classical signs of mediastinal shift and narrowing of the intercostal spaces.

The most important therapeutic measures are intercostal nerve block, tracheobronchial aspiration either with the catheter or the bronchoscope and positive-pressure oxygen therapy. Illustrative case reports are presented.

Diagnosis of Vegetal Foreign Bodies in the Lower Respiratory Tract Raymond S. Rosedale Ohio State M J 42 375-377 April 1948

One of the most important features in the diagnosis of choking or gagging while eating nuts is a history of initial symptoms there is usually a symptom free interval of one day to several weeks. With the development of vegetal bronchitis cough reappears. Expectoration is at first mucoid then purulent or even bloody. The amount of sputum depending upon the degree of ob-

struction With obstructing foreign bodies and retention of secretion, there may be chills, fever, and other evidences of toxicity

Wheezing may or may not be present Breath sounds may be diminished or suppressed over the affected portion of the lung, while those on the opposite side may be exaggerated Tactile and vocal fremitus are diminished The percussion note may be flattened if atelectasis is developing, or tympanic if emphysema is present Inspection of the chest in a good light, with special attention to unilateral impairment of expansion and mobility, is of particular importance

In the early stages radiographs may show no departure from normal As secondary lung changes develop, the findings depend on the type, degree, and site of the bronchial obstruction If a main bronchus is totally obstructed, atelectasis of the involved area will follow, with increased density over the entire lung and shift of the trachea and mediastinum toward the involved side The intercostal spaces will be narrow and the diaphragm may be elevated A so-called compensatory emphysema of the opposite lung may occur

If the foreign body has a ball-valve action, the primary effect will be a trapping emphysema with gradual over-distention of the affected portion of the lung In such a case the trachea and mediastinum will be shifted toward the opposite side the intercostal space will be widened, and the diaphragm on the affected side will be depressed

It is always best to obtain films at the end of inspiration and at the end of expiration Rupture of the emphysematous lung may produce a pneumothorax with typical appearance or an interstitial pulmonary emphysema may develop with a mottled appearance due to contrasting pockets of air around the vascular and bronchial radicles

The foreign body may not obstruct a main bronchus but a secondary one, in which event a lobe or a portion of a lobe will be affected When a foreign body has been in place for some time, secondary pulmonary pathological changes may develop such as multiple abscesses, hydrothorax, or pyothorax It may be necessary to use over penetrated films to delineate the primary condition in such instances

The authors feel it advisable to have a check x-ray examination of the chest three days following removal of a foreign body and if no complications develop again on the seventh day

BERNARD S KALAYJIAN M D

An Investigation into the Radiological Appearances of the Chests of Workers Engaged in the Production of Toxic Gases P H Whitaker Brit J Radiol 19 158-164 April 1946

Irritant gases produce either a primary pulmonary edema or an acute pneumonitis with pulmonary edema as a secondary and incidental manifestation Phosgene is an example of the first type and mustard gas of the second

Radiological appearances are of two types (1) an even density around the hila becoming increasingly less toward the periphery of the lung fields (2) scattered changes—consolidation and opacity—similar to those of military tuberculosis Between these two the author states there must be degrees of less severity with only minor changes visible in the lungs As an example he mentions a study of six persons who had been exposed to phosgene all of whom had a mild degree of dyspnea

The radiographs showed only a mild increase in the hilar density, an increase in the markings around the roots, and a slight increase in the lung reticulation These changes persisted for varying times up to fourteen days, even after symptoms had disappeared

Studies were also made on workers engaged in the manufacture of gases of the mustard type Those exposed to certain chemical processes were found to have a persistent brassy cough Chest roentgenograms of men who had been coughing for three or four months showed little change from normal, but in all there was a slight increase in the root markings at the lung bases In view of the constancy of this latter finding, the study was extended to 105 workmen in another mustard gas factory After six months of employment 6 examples of increased density of the hilar markings and increased striation of the basal root markings were discovered among men giving essentially normal findings before they commenced work A final examination, a year after the first following some decrease in exposure, showed improved radiological appearances

The author assumes from his observations that the lung changes are probably of a simple congestive type and of no serious pathological significance They tend to regress with cessation of exposure to the irritant

SYDNEY J HAWLEY, M D

Significance of Roentgen Examination for Diagnosis and Differential Diagnosis of Acute Interstitial Pneumonia. R Lenk Acta radiol 27 115-128 March 30 1946 (In German)

The role of roentgen examination in the diagnosis of acute interstitial pneumonia (virus pneumonia) is discussed and the great variability of the radiographic manifestations of this disease is stressed The author describes three types none of which however is considered characteristic After discussing the radiographic differential diagnosis, he concludes that the combination of some of the radiographic manifestations with fever shortly after the onset of illness permits the diagnosis of acute interstitial pneumonia with a fair amount of probability

F ELLINGER, M D

Primary Atypical Pneumonia, Virus Type A Brief Review—Necropsy Presentation Jack C Norris Richard F McLaughlin, and S Francis Williams Mil Surgeon 98 299-304, April 1946

A fatal case of atypical pneumonia is reported with necropsy findings The authors believe that trauma such as smoke or gas irritation, or fractured limbs and ribs, initiates the disease in some instances and mention the possibility that allergy may be important in this regard In the case presented the occurrence of symptoms relative to the nervous system is emphasized with the suggestion that the pneumonia might be related to the encephalitic infections Inflammatory lesions were present in this patient's heart, a finding not previously recorded in such cases

Bronchopneumonia Following Ether Anesthesia in Obstetrics Homer C Hartzell and Edward P Munger Surg Gynec & Obst 82 427-433, April 1946

Twenty cases of bronchopneumonia which developed following obstetrical delivery with ether inhalation anesthesia were observed Clinically, the pneumonia did not prove a cause of serious illness and no fatalities resulted Its chief cause was the aspiration of gastric

When the chest wall descends and the negative pressure within the pleural space returns to -5 mm of mercury, the elastic fibers contract and squeeze out the air, creating for the moment a positive air pressure in the air sacs and bronchi. This action must also certainly squeeze the capillaries between the elastic fiber framework on the one side and the air column on the other. The result is a pressure exerted over 140 square meters of capillary surface and the flow of blood is into the veins rather than into the pulmonary artery. A repetition of this action at each inspiration and expiration creates a pumping action upon a large volume of blood and must be quite effective. In other words inspiration and expiration may not only pump the air in and out of the lungs but also pump the blood through the pulmonary capillaries. In atelectasis and pneumonia, there is not only the interference with the capillary flow by compression of the capillaries but also the loss of this auxiliary to the propelling force of the heart action.

A brief summary of the literature is given and important known facts are reviewed concerning the anatomy and physiology of the air sacs and the circulation within the pulmonary capillaries.

CLARENCE D. WEAVER, M.D.

Double-Exposure Roentgenograms of Chest. James Maxwell. *Lancet* 1: 499-500 April 8 1946

A composite roentgenogram showing the respiratory excursion has been found informative in certain chest conditions and should prove of value in the teaching of anatomy and physiology. The same film is exposed twice on maximal expiration and inspiration, and the extent of movement of the ribs and diaphragm is clearly recorded. The exposure time is kept constant and the kilovoltage varied. (On a machine with a delicate timing switch graduated at least in twentieths of a second, an alternative technic is to maintain a standard kilovoltage and to vary the exposure.) The author's technic is similar to that described by Vickers (*Brit J Radiol* 18: 229 July 1945). The first exposure is made on full expiration using the milliamperes-seconds factor which would be used for a standard chest film but increasing the standard kilovoltage slightly ($+5$). The second exposure is then made on full inspiration using the same milliamperes-seconds factor and lowering the kilovoltage to a corresponding extent (-5 or -10). In this way a sharp double outline of the diaphragm can be seen and the movement measured. For an accurate study of the diaphragm the tube should be centered on a level with the muscle, about the plane of the 9th dorsal vertebra but when this is done it is impossible to include the movements of the ribs. To record the movement of the chest as a whole, for the movements of the diaphragm and ribs should be complementary it is necessary to center the tube in the usual way. The diaphragmatic movement appears to be a little less than it actually is but films taken in this way are comparable with each other and the degree of inaccuracy is relatively slight.

The "Wet Lung" in War Casualties. Lyman A. Brewer, III, Benjamin Burbank, Paul C. Samson, and Charles A. Schliff. *Ann Surg* 123: 343-362 March 1946

The problem of the wet lung, i.e. the persistence of fluid in the pulmonary tree following trauma is discussed, on the basis of the authors' combined experience in the management of over 770 casualties in which the chest wound was the primary concern and of the

thoracic complications arising in over 3000 other casualties of all types. Fluid may be present in various forms—mucus, blood, serum, etc. Two groups of factors are of importance in the development of wet lung: (1) forces leading to the production of secretions and other fluids in abnormal amounts in the respiratory tract and (2) conditions preventing adequate removal of the fluids so produced. In war casualties many conditions are present which favor both the accumulation and inadequate expulsion of fluid material from the pulmonary tree.

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Since it is nearly as accurate, the 70-mm film would seem to have its place in large industrial surveys, military screening, progressive surveys in metropolitan centers, mental hospitals, and other institutional examinations.

L. W. PAUL, M.D.

Parapneumonic Bullous Emphysema in Infants Ada Middelhoven. *Acta paediat* 33: 119-128, 1946

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This condition has frequently been seen in infantile pneumonia. It has most often been confused with congenital cystic disease, lung abscess, and tuberculosis. The transient nature and constantly changing appearance of the bullae establish the diagnosis. Many will balloon up and deflate in a short period of time without any treatment other than supportive measures. The general opinion is that these cavities originate by a check valve mechanism. Thickened mucous membrane, plugs of secretion or scar formation cause a partial obstruction of the afferent bronchioles.

Illustrations are included showing the course of the lesion from its discovery until its disappearance.

[A case similar to the one recorded here was presented by the abstractor at the film reading session of the Radiological Society of North America, on Dec. 1, 1946.]

STANLEY H. MACHT, M.D.

Transitory Pulmonary Infiltrations (Loeffler's Syndrome) in Rabbits Peter A. Herbut and Frank R. Kinsey. *Arch Path* 41: 489-502, May 1946

Löffler's syndrome as observed in man was duplicated in rabbits by giving sensitized animals single or multiple intratracheal instillations of horse serum. Clinically the animals presented only slight disturbances. Roentgenography revealed transitory pulmonary infiltrations that cleared in from seven to thirteen days. On pathologic examination there were congestion, edema and eosinophilic infiltration of the submucosa of the trachea and the bronchi; in the lung parenchyma there were congestion, edema, atelectasis, emphysema, and an eosinophilic pneumonia. Eosinophils were found in the tracheal secretions. The syndrome in rabbits differed from that usually seen in man in that (1) there was no eosinophilia and (2) the pulmonary shadows were not migratory. It is concluded that Löffler's syndrome is an allergic inflammation of the lungs and that one route by which the allergen invades is that of inhalation.

Pulmonary Hydatid Disease. The Sign of the Camalote James A. Jenkins. *Australian & New Zealand J Surg* 15: 296-298, April 1946

South American surgeons who have the opportunity of seeing a considerable number of cases of hydatid disease have described a rather unusual sign which they

consider pathognomonic of hydatid lung cyst. This is the "sign of the camalote," so-called from its resemblance to a South American river plant bearing that name, not unlike a water lily.

As a result of erosion by an impinging cyst, a bronchus may eventually communicate with the potential space between the adventitious pericyst and the hydatid membrane. When sufficient air enters this space to cause complete separation and collapse of the hydatid membrane, with loss of much of the hydatid fluid through the bronchial fistula, a characteristic wavy mass of parasitic membrane lies within the air-filled pericyst, moving within the cyst on a small amount of remaining fluid. It is this appearance that is known radiologically as the sign of the camalote. The author in a report from New Zealand describes a case in a child of six in which this sign was present.

[An excellent diagram showing this appearance is included in a report by Evans in *Radiology* 40: 365, 1943.—Ed.]

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Geotrichum resembles *Blastomyces dermatitidis* and *Coccidioides immitis* in many respects. The genus is quite large, the species being mostly saprophytic on earth and decaying organic matter. Infection by *Geotrichum* is rare.

The authors present the case history of a young colored man who had been stationed in western Texas for one month. He complained of chest pains, which disappeared in a few days. About three months later he had a recurrence of the chest pain, accompanied by night sweats, weakness, cough, productive of small amounts of mucoid sputum, and weight loss. A friction rub was heard over the chest. Roentgenographically diffuse mottling was demonstrable in both lungs. The symptoms were thought to be due to coccidioidomycosis or pulmonary metastases, but all laboratory studies were negative except that *Geotrichum* was found on culture. Under sodium iodide therapy, the infiltrations cleared completely in three months.

While it is true that yeasts may contaminate sputum specimens in the laboratory, and be present in the respiratory tract as non-pathogenic organisms, it is also recognized that they may act as both primary and, more often, as secondary invaders. It is highly important that repeated examinations be made for tubercle bacilli before tuberculosis is excluded. Peterson (*Radiology* 43: 14, 1944) stated that "any lesion having the appearance of tuberculosis in which no tubercle bacilli can be found should be studied carefully to rule out a fungus infection. In patients in whom no definite organism can be isolated, a therapeutic test with iodine may be instituted and the final diagnosis based on the response."

Geotrichum was isolated from two other cases of chronic respiratory disease but in these there was no evidence of pulmonary infiltration roentgenographically.

BENJAMIN COPELAND, M.D.

Pulmonary Acariasis. Its Relationship to the Eosinophil Lung and Löffler's Syndrome A. van der Sar. *Am Rev Tuberc* 53: 440-446, May 1946

The author reports a study of 8 cases of the syndrome known as tropical eosinophilia. Clinically the pa-

contents as a result of vomiting. The possible contributory role of (1) preanesthetic medication, favoring suppression of the cough reflex, (2) prolonged gastric evacuation in labor and (3) fluidity of the gastric contents, favoring their dissemination in the bronchial tree, is discussed.

The bronchopneumonias varied in extent from isolated patches to extensive bilateral infiltrations and were observed in all portions of the lung fields. The less extensive cases presented the picture of "soft" fluffy localized shadows of increased density which, when situated in the upper lung fields closely simulated the early infiltrations of adult tuberculosis. The more extensive bilateral cases showed symmetric extensive coalescent densities, with a tendency to central localization, resembling pulmonary edema. A variety of intervening patterns were also seen, indistinguishable from bronchopneumonias due to other causes. Usually there was an associated generalized increase in prominence of the vessel markings, suggestive of pulmonary hyperemia. None of the patients showed mediastinal displacement or other evidence of massive atelectasis.

Clearing of the infiltration was rapid in most cases and complete in all. Fifteen of 18 cases in which serial films were available showed complete clearing in a week or less.

On strictly objective criteria, a roentgen diagnosis of aspiration pneumonia is not possible but its recognition is usually easy if the roentgenologist knows the clinical findings and is familiar with the condition. It is differentiated from both pulmonary tuberculosis and sarcoidosis by its rapidity of clearing as seen on serial films. It differs from lobar or massive atelectasis in its patchy character and in the absence of mediastinal displacement. Dependence must be placed upon the clinical findings to differentiate it from bronchopneumonias and pulmonary edemas of other etiology.

Roentgen and Clinical Problems in So-Called Solitary Metastatic Tumors in the Chest. Frederick B. Mandeville. *Am J Surg* 71: 669-675 May 1946.

The author points out that with increased skill and experience of thoracic surgeons the responsibilities of the roentgenologist for the diagnosis of chest tumors has become correspondingly heavier. He presents brief accounts of 5 cases of solitary metastatic chest tumors seen in his own radiologic experience. Pneumonectomy was done in 4 cases. One patient died in the operating room. 2 died less than a year following operation. A fourth was alive after a brief interval but with other metastases discovered at operation, in the fifth a metastatic hypernephroma involving the sternum was mistakenly diagnosed as a primary bone tumor the sternum was excised and the patient subsequently died with multiple lung deposits.

A number of cases from the literature are also reviewed. There were several postoperative deaths but a number of patients survived for varying periods. One was alive thirteen years after nephrectomy for the primary tumor, followed fifteen months later by subtotal lobectomy for a solitary metastasis.

Among the points stressed are the low incidence of proved single metastatic tumors in the chest or, indeed anywhere in the body, the impossibility of differentiating many benign from malignant chest tumors by roentgenology alone, the frequent difficulty of distinguishing between primary tumors and solitary metas-

tases on the basis of x ray findings alone. It is concluded that the many problems associated with solitary metastatic tumors of the chest remain unsolved and that methods of treatment are still in an experimental stage.

FREDERICK A. BAVENDAM M.D.

On the Value of Planigraphy in Bronchial Cancer. J. Frimann Dahl. *Acta radiol* 27: 99-114 March 30 1946.

Three methods are available for the roentgen localization and diagnosis of bronchial tumors so-called air bronchography, oil bronchography, and planigraphy. The author presents a series of 56 cases in which planigraphy was done and a diagnosis of carcinoma was confirmed microscopically or was otherwise reasonably certain. Many of the patients were examined by the other methods also. Air bronchography was found to be of limited value and oil bronchography has the disadvantage of being uncomfortable for the patient, as well as entailing danger of oil retention in the lungs, with the possible production of secondary atelectasis.

In 48 of the 56 cases, planigrams sufficed to localize the tumors. To obtain satisfactory roentgenograms, each patient was examined fluoroscopically and placed in the optimum position with the involved bronchus parallel to the selected plane for roentgenography, usually a frontal or oblique position but occasionally lateral. In those cases in which there was complete stenosis of a bronchus with an atelectatic wedge diagnosis was easy. Tumors which presented themselves as a mass surrounding a bronchus and with some invasion of the wall were likewise identified by planigrams. The author believes that such complications as cavities and bronchiectasis are more easily demonstrated by planigraphy than by other methods. In general the nearer the tumor is to the large bronchi the easier and more reliable is the planigraphic diagnosis.

Differential diagnosis includes benign tumors, foreign bodies and lung abscess. In only three cases in this series did oil bronchography prove to be superior to planigraphy.

ELIZABETH A. CLARK M.D.

Mass Miniature Radiography of Children. R. A. Reynolds. *Irish J M Sc* No 244 April 1946 pp 134-136.

The author believes that the application of mass miniature radiography is justified economically by its relatively low cost and the economic loss involved by each tuberculous patient who has to be supported during a long period of inactivity. The number of cases of active tuberculosis uncovered by this means among 397 school children from Cork and Dublin was 22, or 17 per cent representing about 3 per cent of all those reacting positively to tuberculin.

The author notes that in one of the schools only the positive tuberculin reactors were examined and from his findings it would seem to be more economical to limit the survey to such groups.

SYDNEY F. THOMAS M.D.

Photoroentgenographic Results. A Comparison of the 4 X 5" and the 70 mm Equipment in 1,713 Cases. Frederick Tice. *Am Rev Tuberc* 53: 454-467 May 1946.

In order to determine the relative efficiency in tuberculosis survey work of the 4 X 5-inch and the 70-mm film the author and his associates conducted a compara-

tive survey in 1,713 cases. The results are presented in tabular form. The final studies led to the diagnosis of 37 cases of reinfection tuberculosis and 23 suspects. Of these, one was missed on the 70 mm film, the only significant variation in the entire series.

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tients had attacks of asthmatic bronchitis or of bronchitis without asthma. The peripheral eosinophil count ranged up to 80 per cent. Mites were present in the sputum in all 8 cases. In one, the adult form of *Tyroglyphus* was found. In 6 others the mite was believed to be in a hypopal stage and in one the mite had not been identified.

One patient showed no roentgenographic changes in the lungs, 2 revealed transient infiltrates similar to those seen in Löfller's syndrome. In the remaining 5 the changes were typical for "eosinophilic lung," i.e., enlarged hilar markings and a fine mottling with ill defined spots scattered throughout the lung. After treatment with mafarside or carbason the symptoms disappeared and the x-ray findings cleared.

L W PAUL M D

Thoracic Gastric Cyst. Anibal Roberto Valle and M Lawrence White, Jr. *Ann Surg* 123: 377-383, March 1946

A case of thoracic gastric cyst of entodermal origin in a 22-month-old girl is presented. Symptoms of a "cold" appeared shortly after birth and persisted until the age of four months when the patient began to have severe paroxysms of coughing accompanied by cyanosis. A diagnosis of "membranous croup" was made by the family physician. A chest film at that time is said to have revealed pneumonia. A wet paroxysmal cough, fever, hoarseness, and episodes of cyanosis persisted despite several courses of sulfonamides. Serial chest films showed what was interpreted as a chronic pneumonia on the right side which in view of the prolonged illness was finally diagnosed by the family physician as a lipid pneumonia. At the age of seven months the patient coughed up a large quantity of bright blood. Clubbing of the fingers was noticed at this time. From then until the child was seen by the authors seven severe pulmonary hemorrhages occurred, each requiring hospitalization and multiple transfusions. Only in recent weeks had the persistently wet cough resulted in the expectoration of grossly purulent sputum.

The patient was poorly developed, undernourished, and obviously chronically ill, weighing only 18 pounds. Marked clubbing of the fingers and toes was present. The chest had an enlarged anteroposterior diameter suggesting emphysema. Auscultation elicited coarse moist râles bilaterally from apex to base, particularly on the right.

Roentgenography of the chest revealed a marked mottled infiltration particularly in the right lower lobe with some involvement also in the middle and upper lobes. There was a dense elliptical shadow in the right hilar region which was thought to be an enlarged hilar node. No evidence of cavitation was seen. The left lung was essentially clear. A review of the old films disclosed similar hilar adenopathy and infiltration in the right lung.

Bronchograms showed generalized bronchiectasis of the right lung and a large cavity in the posteromedial portion of the right lower lobe. The oil flowed readily into this cavity through a large bronchial communication.

A diagnosis of bronchiectasis with an infected bronchial cyst was made. Surgical extirpation of the diseased lung was decided upon in spite of the patient's poor general condition. Just above the diaphragm in the lower lobe was a dense mass, apparently inflam-

matory, about the size of an egg. This mass was presumed to represent the cystic area seen roentgenographically. This portion of the lung was separated from the parietal pleura but in so doing the cystic cavity was broken into and the peripheral portion of the cavity wall, densely attached to the diaphragm and posterior gutter, remained behind as the mobilization of the lung was completed. The lung itself was obviously infected, with areas of dense inflammatory infiltration from apex to base. The patient died during the operation. Further exploration revealed that complete excision of the cyst wall would have been an impossible surgical feat. Closer examination of the lining of the cyst suggested typical gastric mucosa with rugae, and the true diagnosis was first suspected at this time. Remnants of the cyst were found to extend down through the diaphragm in intimate contact with the inferior vena cava, the bodies of the vertebrae, and the esophagus. The cyst ended blindly about 5 cm. below the diaphragm, without anatomic continuity with either esophagus or stomach.

Radiotherapeutic Test in the Differential Diagnosis of Mediastinal Pathology. Simeon T. Cantrell and Franz Buschke, Editors. *Radiation Therapy Conference*. West J Surg 54: 166-169, April 1946.

The response of a mediastinal lesion to x-ray therapy has long been used as an important adjunct in differential diagnosis. In the analysis of the results of such radiotherapeutic tests it must be realized that lesions that do respond to radiation may vary widely in their degree of radiosensitivity and in the rapidity of their response. The authors give two examples which emphasize this point.

(1) A man of 36 had had a right oleothorax for tuberculosis for eight years. A few months before admission he experienced a choking sensation which rapidly became worse. He was observed for several months in a sanatorium and the dyspnea became more severe during that time. At the time the authors first saw him he had marked cyanosis of the face, enlargement of the superficial skin vessels, extreme dyspnea, and a normal temperature. A chest film showed displacement of the heart and mediastinum to the left with a fluid level in the right chest field. There was a large mediastinal mass measuring 17 cm. in diameter. Since the diagnosis was equivocal and since the possibility of a mediastinal lymphoblastoma without relationship to the previous oleothorax had to be excluded a radiotherapeutic test was given. On the morning after the first treatment (85 r on the skin with 200 kv and 2 mm. copper filtration) the patient could breathe easier and after four treatments (a total of 385 r) he appeared practically normal. A film made four days after the first application of the rays showed complete disappearance of the mediastinal mass. Because of the rapid and complete response it was believed that the lesion was a preleukemic mediastinal lymphoblastoma. The patient was discharged in January 1941 in excellent condition having received a total of 535 r to the mediastinum. Within two months all the classical signs of lymphatic leukemia were present. Autopsy showed widespread lymphomatous infiltration.

The second patient was a 28-year-old woman who was admitted in February 1942. In the fall of 1941 a diagnosis of Hodgkin's disease was made on clinical

grounds, but this diagnosis was rejected because a mediastinal mass failed to respond to a therapeutic test. The total dose given was around 1,000 r (200 kv, 0.5 mm copper filtration) and the observation time was three weeks. When the patient was seen in 1942, her main complaints were coughing and choking spells. A lymph node removed from the right supraclavicular fossa showed definite early Hodgkin's disease. A chest film in January 1942 revealed a mass measuring 8 cm in diameter in the upper anterior mediastinum. Between Feb 10 and March 9, 1942 this patient was given 5,300 r measured on the skin (200 kv, 2.0 mm copper filtration) equally divided between anterior and posterior mediastinal fields. During the first treatment week there was increase in dyspnea with development of a mild edema of the neck. Treatment was continued, however, and clinical improvement was noted after twelve treatment days. It was only after 36 days that real diminution of the mediastinal mass could be determined roentgenographically. Radiation therapy was continued until the total dose over two fields was 7,100 r in 43 days. A film obtained Aug 19, showed an entirely normal chest with complete absorption of the mediastinal tumor. Repeated examinations since that time have shown no recurrence.

As these two cases show, certain types of Hodgkin's disease and other lymphoblastomatous lesions require considerably more radiation and considerably longer observation periods than is generally supposed. In some of these cases the required dosage may very closely approach a cancer sterilizing dose.

BERNARD S KALAYJIAN, M D

Longevity with Ventricular Aneurysm. Case Report with Survival of Fifteen Years. Sidney L Penner and Michael Peters. New England J Med 234: 523-526 April 18 1946

The prevailing opinion about cardiac aneurysm is that the life expectancy is rather short. The present report concerns a man who had coronary disease in 1929 at the age of forty three and suffered several attacks of cardiac pain in the following four years. In 1945 another attack of left shoulder pain with radiation down the left arm occurred and a chest film showed slight cardiac enlargement. There was a curvilinear band of calcification over the left ventricular region, which at fluoroscopy was seen to be in the outer surface of an old outpouching of the anterior surface of the left ventricle. In the latter part of 1946 this patient is still well and active.

The following changes are most frequently found in cardiac aneurysm: enlargement of the left ventricle with deformity of the contour; a localized protuberance; absence of pulsation; evidence of adhesions and calcification of the aneurysmal wall or interventricular clot.

Since this patient had several long periods of bed rest it is believed that this is an important feature in the therapeutic handling of coronary heart disease.

JOHN B McANENY, M D

Movements of the Mitro-Aortic Ring Recorded Simultaneously by Cine-roentgenography and Electrocardiography. Bengt S Holmgren. Acta radiol 27: 171-176 March 30 1946 (In English)

Previous studies of the use of cine roentgenography to trace the movements of intracardiac calcifications in the mitro-aortic ring describe the motion as roughly triangular in its course. The author reports two cases in which a similar study was made synchronized with electrocardiography. The movement in each of these cases was in a straight line. By correlating the electrocardiographic findings with the observed motion of the calcifications it was found that the highest point of excursion occurred in presystole. When the ventricles began to contract at R of the QRS-complex, the annulus fibrosus was displaced toward the cardiac apex, and motion stopped at the end of ventricular contraction, corresponding to the point just after the T wave.

ELIZABETH A CLARK, M D

Roentgenologic Changes Observed in Tropical Diseases. Harry M Weber. Am J M Sc 211: 629-636, May 1946

In this "Progress of Medical Science" paper the author reviews the recent literature on the roentgenologic aspects of tropical disease and points out the necessity that roentgenologists and their consultants in internal medicine should be prepared to think in terms of tropical diseases and their late sequelae. Most of the material cited has appeared in RADIOLOGY in the original or abstract form.

THE DIGESTIVE SYSTEM

Radiological Diagnosis of Certain Diseases of the Lower Esophagus. J W McKay. S Clin North America 26: 306-318, April 1946

The author points out the importance of radiologic examination of the esophagus in the presence of thoracic pain. He precedes his discussion of various esophageal conditions by a description of the radiologic technique and sections on anatomy and physiology which should be read and re read for their clear cut dynamic picture of the esophagus in action.

Though esophageal hiatus hernia is hardly to be classed as a disease of the esophagus, it is considered here because of its resemblance to the phrenic ampulla. An esophagus of normal length may enter the stomach below the diaphragm and the gastric hernia may be only partial or the lower end of the esophagus may also be elevated above the diaphragm. In either case, the diagnosis is relatively easy because of the large size of the hernia and the presence of gastric rugae in the thorax. The esophagus enters the herniated cardia from the medial side, thus distinguishing true herniation from a congenitally short esophagus with thoracic stomach. The position of the esophagus is best determined with the patient supine with the left shoulder rotated toward the fluoroscopic screen. Marked kinking is not seen. The type of hernia designated as hiatus insufficiency is more difficult to differentiate from the phrenic ampulla. The Valsalva maneuver which is useful in demonstrating the ampulla also aids in demonstrating or perhaps producing, protrusion of the cardiac end of the stomach in hiatus insufficiency. The difference in the mucosal pattern of the stomach and esophagus may be of help in diagnosis.

The x-ray picture in long standing *cardiospasm* is characteristic. The esophagus dilates to a marked degree and eventually becomes elongated and tortuous. As it increases in size it produces widening of the mediastinal shadow to the right. The lower end of the

dilated esophagus is usually smooth narrow, and conical in shape, though the smooth appearance may be altered by a complicating esophagitis and ulceration above the obstruction. Conditions to be differentiated are benign stricture and carcinoma.

Esophagitis is described as showing spastic contractions, stenosis, and distortion of the mucosal folds.

Carcinoma of the esophagus may be of the stenosing infiltrating or scirrhous type, producing a circular stenosis, of the medullary type, which ulcerates early and produces an irregular filling defect in the barium filled esophagus, or of the polypoid form which is rarely recognized radiologically.

Varices may be demonstrated by the Valsalva test

SYDNEY F. THOMAS, M.D.

Diagnosis and Differential Diagnosis of the Phrenic Ampulla, the Short Esophagus with Partial Thoracic Stomach, and Hernia of the Esophageal Hiatus R. P. O'Bannon. *South M. J.* 39:320-325 April 1946.

The recognition of the phrenic ampulla, the congenitally short esophagus, and true hernia through the esophageal hiatus is essentially a radiological problem. There is no group of clinical symptoms which can be regarded as characteristic of these conditions.

The normal esophagus is considered to be a hollow muscular tube of uniform transverse diameter throughout its extent and so it appears on the roentgen film. It ends in a sort of flat, conical constriction at the cardiac orifice of the stomach. The rugae are quite characteristic and are readily demonstrated with the barium meal appearing as practically continuous long thin lines of barium, usually unbranched. The phrenic ampulla appears as a sacular dilatation of the lower end of the esophagus, sometimes small, sometimes more prominent, with a slight band like constriction at its upper margin. Its recognition is of importance only that it may be differentiated from other conditions as it has no pathological significance. It is exaggerated by rapid swallowing of the barium mixture or by increase of intra abdominal pressure as by the Valsalva experiment. It disappears partially or completely on completion of the swallowing act. The normal rugal markings of the esophagus may be readily traced through the phrenic ampulla.

The congenitally short esophagus with partial thoracic stomach when completely filled with barium like the phrenic ampulla presents a bulbous dilatation with a band-like constriction at its upper margin marking the termination of the esophagus. Usually there is a much less prominent constriction at the diaphragm. With the patient lying on the back and turned moderately to the left the filled bulbous portion of the stomach may be observed over a long period of time. It rapidly empties on assumption of the erect position. Fluoroscopically the esophagus may be seen to enter directly the apex of the bulbous dilatation. On turning the patient on the abdomen gravity allows the meal to flow into the pyloric end of the stomach with partial emptying of the fundus. The coarse gastric rugae quite different from the linear rugae of the esophagus, can then be visualized. Furthermore the gas bubble floats into the fundus and the gas shadow more clearly outlines the thoracic portion of the stomach. Confirmation of the diagnosis may be obtained by esophagoscopy examination.

In the presence of true hiatus hernia if the patient is placed on his back and turned moderately to the left the

first swallow of barium will be seen to descend through the entire esophagus and enter the abdomen and then appear in the herniated portion of the stomach. By rotating the patient a position may be found where the completely filled esophagus can be demonstrated as it passes around the herniated portion of the stomach and enters the fundus. The lower portion of the esophagus may be displaced medially, forming a hook like curve about the hernia. If the hernia produces pressure on the lower end of the esophagus it may be moderately dilated. When the patient is turned on the abdomen permitting the barium to flow toward the pyloric end of the stomach, the characteristic appearance of the gastric rugae will be shown in the herniated portion. If barium clings to the walls of the lower part of the esophagus, the rugal pattern of the esophagus may be demonstrable passing around or across the herniated portion of the stomach according to the position of the patient.

BERNARD S. KALAJIAN, M.D.

Atresia Oesophagi Congenita with Oesophago-Tracheal Fistula. P. M. Kjelland. *Acta paediat.* 33:151-157, 1946.

A case is reported of congenital esophageal atresia at the level of the fourth thoracic vertebra associated with an esophagotracheal fistula between the bifurcation of the trachea and the lower portion of the esophagus. The infant was born at full term. It vomited from birth but lived for five days. Roentgen examination with barium sulfate demonstrated the blind pouch of the upper esophagus. It also showed air in the stomach and intestines. No other congenital anomalies were found. Illustrations of the roentgen findings and autopsy specimen are included. Theories of the development of this anomaly are presented.

PAUL W. ROMAN, M.D.

Chronic Ulcerative Oesophagitis with Report of a Case of Ulcer in Oesophageal Varices. George Steiner. *Brit. J. Radiol.* 19:145-152 April 1946.

Since a circumscribed crater niche is seldom demonstrable in the esophagus, indirect signs are of importance for the diagnosis of esophageal ulceration. Among these are delay in the passage of barium, spasm, stenosis, dilatation, abnormal peristalsis and hypertrophic changes in the mucosa, all of which however may occur in other conditions and serve only to indicate the esophagus as the site of the lesion. Other indirect signs indicative of chronic inflammation or swelling are irregularity of rugal alignment, persistent coarsening of or granular thickening along the folds, loss of pliability or even rigidity of the rugae and poor definition or loss of the mucosal pattern. There may also be evidence of peri esophageal adhesions within or above the hiatus.

Three conditions—exclusive of foreign bodies, corrosive agents, specific diseases and tumors—predispose to the development of chronic ulcerative esophagitis. These are: (1) the presence of gastric juice from ectopic deposits of gastric mucosa or as a result of regurgitation through an unduly patent cardia or in association with a hiatal hernia; (2) debility due to systemic disease causing a generally diminished tissue resistance; (3) local factors such as hiatal hernia, irritation from a postoperative suction tube or esophageal varices.

Four cases are recorded. In one of these ulceration was associated with varices presumably due to splenic vein thrombosis.

SYDNEY J. HAWLEY, M.D.

Partial Transposition of the Upper Abdominal Viscera. A P Guttman and I Maclaren Thompson
Canad M A J 54 486-487, May 1946

The authors point out that apart from extensive visceral transposition dextrogastria is exceedingly rare. A case is reported in which roentgenologic studies showed the stomach transposed to the right side of the abdomen and the duodenum to the left. The colon was in the normal position but the descending colon was nearer the median plane than usual. The gallbladder was on the left side, and the heart in normal position. The liver appeared to be on the left, the tail of the pancreas and the spleen were presumably on the right side.
BERT H MALONE, M D

Emphysematous Gastritis. H Stephen Weens
Am J Roentgenol 55 588-593 May 1946

Emphysematous gastritis is an inflammatory process of the stomach caused by a gas forming organism. It was first recognized by Fraenkel in 1889 (Virchow's Arch f path Anat 118 526-535 1889). Weens reports a case in a man aged thirty seven, following the ingestion of concentrated hydrochloric acid. Extensive gas formation in the gastric wall was demonstrated roentgenologically for a period of approximately four weeks. The infection was followed by extensive scar formation which resulted in complete obstruction of the midportion of the stomach and necessitated two gastrotomies. *B. proteus* was cultured from the stomach contents and *A. aerogenes* was grown from a blood culture. A subphrenic abscess and multiple liver abscesses followed the second gastrotomy, and the patient died.

The roentgen diagnosis of emphysematous gastritis depends upon the demonstration of gas formation in the wall of the stomach. If the stomach contains fluid, the gas-containing wall will show sufficient contrast to be recognized as a zone of decreased density. On examination in the recumbent and upright positions, the gas cysts will maintain constant position regardless of posture. Oral contrast media will permit exact localization of the visceral lumen. In the differential diagnosis pneumatosis intestinalis cystoides must be ruled out. This is characterized by the formation of gas vesicles in the intestinal wall. It has rarely been observed in the stomach. It is usually an incidental finding in association with chronic gastric and duodenal ulcer and does not produce clinical symptoms.

CLARENCE E WEAVER, M D

Decrease in Size of Niche in Cancer of the Stomach.
Hans Hellmer Acta radiol 27 153-170 March 30 1946 (In German)

Four cases are reported in which roentgen examination of the stomach revealed a definite decrease in the size of a niche. In each instance, the niche was found at operation to be of cancerous origin. Decrease in size of a niche following internal treatment cannot therefore be used in the differential diagnosis between gastric ulcer and carcinoma of the stomach.

F ELLINGER, M D

Congenital Duodenal Stenosis. Report of a Case.
C L Tucker New Zealand M J 45 118-120 April 1946

A case of congenital duodenal stenosis which remained undiagnosed until the patient was six years of

age is presented. At the age of eighteen months the child began having intermittent vomiting attacks lasting from one to three weeks followed by freedom from symptoms for three or four months, he was hospitalized on several occasions, but no x-ray investigations were carried out. When roentgen studies were eventually made, they showed that the stomach was not unduly dilated, the pylorus and duodenal cap filled, but there was dilatation of the descending and proximal transverse loops of the duodenum, with pooling of the barium in the dilated portion. The condition was treated successfully by anterior duodenojejunostomy (because of a distended and congested mass of veins in the mesocolon, it was impossible to do a posterior anastomosis). This case shows the necessity for careful roentgen examination in children with a history of periodic vomiting attacks.

Acute Gastroduodenal Obstruction (Dilatation).
William C Beck Arch Surg 52 538-546, May 1946

Acute gastroduodenal dilatation is usually due to an obstruction of the duodenum by compression between the superior mesenteric artery and the vertebral column and aorta. It usually occurs in a debilitated or emaciated patient who is forced to lie on his back. Judging from reports, it is a fairly common condition. The author saw 4 cases in wounded soldiers in seven months. The most prominent symptom is vomiting, copious in amount and associated with nausea. Large amounts of fluid may be obtained from the stomach by aspiration. Periumbilical pain is usually present.

The diagnosis is made on the roentgenogram (scout film), which shows pronounced dilatation of the first and second portions of the duodenum. A lateral roentgenogram of the abdomen demonstrates the posterior position of the air in the duodenum, at the point of blockage, and is a conclusive test. The author recommends the recumbent position and believes a search for fluid levels is useless and confusing.

Treatment is aimed at keeping the stomach empty, relieving the obstruction, and correcting the electrolytic and nutritional deficiency. The second point is accomplished by decompression and positioning (the knee-chest position is especially useful). Operation is rarely indicated. The prognosis is good, but before discharge roentgenologic study should be undertaken to determine whether a chronic duodenal ileus is still present.
LEWIS G JACOBS, M D

Foreign Bodies in the Duodenal Cap. Giuseppe de Andra Radiol med (Milan) 32 108-121, April 1946

De Andra describes several cases of foreign bodies in the duodenal cap and in the duodenal loop, which were ingested by malingering Italian soldiers attempting to confuse radiological examination. Good roentgenograms show the appearance of these foreign bodies which were ingested immediately prior to the examination and were mostly of vegetable nature.

CESARE GIANTURCO, M D

Diverticula of the Jejunum—with Report of Two Cases. Carrington Williams and John B Walker Virginia M Monthly 73 212-215 May 1946

Three hundred cases of diverticula of the jejunum have been reported to which the authors add two. They point out that the presence of diverticula does not

dilated esophagus is usually smooth, narrow and conical in shape, though the smooth appearance may be altered by a complicating esophagitis and ulceration above the obstruction. Conditions to be differentiated are benign stricture and carcinoma.

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SYDNEY J. HAWLEY, M.D.

result in abnormal function, so that there is no manifestation of their presence until some complication develops. When the diverticula become acutely inflamed symptoms of acute abdominal inflammation develop and perforation may ensue, leading to local or general peritonitis. In chronic cases, if the inflammation results in considerable infiltration of the adjacent bowel, there may be signs and symptoms of partial obstruction. If diverticula become filled with intestinal contents and empty poorly, vague pain, flatulence, and intestinal disturbances occur. There is thus no characteristic clinical picture and the diagnosis is dependent upon x-ray demonstration of the diverticulum. This examination is contraindicated however, in the presence of acute inflammation and is not always satisfactory in chronic cases.

The first of the authors' patients gave a history of chronic gastro-intestinal complaints and a jejunal diverticulum was demonstrated roentgenographically. At operation, two diverticula were found, each with a small opening into the jejunum on the antimesenteric border. Both were successfully excised and relief of symptoms followed.

The second patient was acutely ill, with symptoms leading to a preoperative diagnosis of ovarian cyst strangulated by a twisted pedicle. This diagnosis was confirmed at operation, and further exploration revealed an inflammatory mass above and to the left of the navel. This was found to have resulted from a perforation of a diverticulum which was well walled off by adjacent loops of bowel. A large number of other diverticula were seen along the mesenteric border in a segment of jejunum about 24 inches in length. The perforated diverticulum was excised and the small defect in the bowel wall closed with a purse string suture. The patient made a satisfactory recovery and six weeks later the segment containing the remaining diverticula was excised and an end-to-end anastomosis was done. Recovery was again uneventful, and the patient has remained well since.

These cases represent the congenital type of diverticula since all the layers of the bowel were present in their walls.

J E WHITELEATHER M D

Cystic Fibrosis of the Pancreas T B Merner J F Bosma and A J Moss Minnesota Med 29 429-436, May 1946

Clinically cases of cystic fibrosis of the pancreas closely resemble the more familiar celiac disease. Both conditions are characterized by bulky stools, abdominal enlargement and signs of nutritional deficiency. Cystic fibrosis of the pancreas, however, is actually a generalized disorder one of the striking manifestations of which is chronic disease of the respiratory tract.

In a certain percentage of cases death occurs within a few days of birth and the intestine is found to be obstructed by an unusually viscid meconium. In a case of this type reported here persistent respiratory difficulty followed laparotomy and death ensued on the fourth day of life. Autopsy showed increased amounts of thick mucus in the bronchi and bronchioles and characteristic changes in the pancreas—atrophy of the exocrine parenchyma and dilatation of the ducts, which were filled with inspissated secretion. Children who survive longer are peculiarly susceptible to chronic respiratory infection with progressive secondary emphysema and bronchiectasis. The accumulation of the typical viscid bronchial secretions may cause episodes of

dyspnea and wheezing, and death is commonly due to bronchopneumonia. Retardation of physical growth is a secondary feature leading to dwarfism in the older patients.

The etiology remains obscure. The authors find Farber's theory (Arch Path 37 238 1944) most acceptable. According to this view the mucous secretions of these patients are characteristically viscid, causing mechanical obstructions which lead to the cystic changes in the pancreas and play an important role in the development of pneumonia. There seems to be a familial tendency in that several siblings are likely to be affected.

The single laboratory test which provides a valid basis for the diagnosis of cystic fibrosis of the pancreas in the living patient is analysis of the pancreatic juice as obtained by duodenal aspiration. Even in cases with minimal disease there is usually complete absence of trypsin. Under the heading of Roentgenologic Findings, mention is made of Golden's "segmentation" effect in the small intestine, thickening of the mucosal folds with elimination of the fine mucosal pattern, and hypomotility, but these findings are not specific. The pulmonary changes are said to be quite characteristic. The disease is diffuse, is of chronic nature, and appears to be progressive. Mottled densities are seen in both hilar regions, extending in streaked fashion into the peripheral areas of emphysema. The findings are sufficiently suggestive to be recognized in the chest roentgenogram, and other diagnostic procedures should then be carried out.

The greatest known age of survival with this disease is fourteen years.

The authors' observations are based on 8 cases, details of which are presented in tabular form.

Pancreatic Heterotopia Review of the Literature and Report of 41 Authenticated Surgical Cases, Which 25 Were Clinically Significant. Jorge J de Castro Barbosa Malcolm B Dockerty and John M Waugh Surg Gynec & Obst 82 527-542, May 1946

Abnormally located masses of pancreatic tissue originate antenatally as a result of incomplete regression of the left ventral anlage which normally atrophies or of engrafting of portions of the rudimentary ducts on the gastric or intestinal wall or the mesentery or it may be that lateral buds become pinched off when they penetrate the gut wall and are carried up or down by longitudinal growth.

Heterotopic pancreatic tissue is discovered in 0.6 to 5.6 per cent of routine necropsies and is found once in approximately every 500 operations on the upper abdomen. A review of the literature indicates that some 430 cases were recorded up to March 1944 and to these the authors add 41 authenticated cases from the Mayo Clinic and an equal number of cases unproved by histologic study. The ratio of males to females is 3 to 1.

In about 70 per cent of cases the heterotopic tissue is located in the stomach, duodenum or jejunum. The ileum, spleen, biliary tract, mesentery, omentum, and various diverticula are less usual sites. The deposits are for the most part single measuring 1 to 4 cm in diameter. Grossly and microscopically they resemble the pancreas. More than half are limited to the submucosa but muscular coats and serosa may also be involved. Most show evidence of acinar function, and hyperinsulinism and hypoglycemia may result from an extrapancreatic adenoma.

The same pathological changes occur as in the pancreas itself but malignant changes are more apt to take place than in the pancreas proper. Adjacent tissues may also show changes, such as ulceration of the mucosa, diverticulum formation, necrosis or hemorrhage.

In many of the cases the lesions are clinically important, the stomach and duodenum being the sites of involvement. Symptoms vary with location and are similar to those of other gastroduodenal lesions. Adenocarcinomas of the duodenum may originate in aberrant pancreatic tissue. Sixty one per cent of the authors' authenticated cases were clinically significant.

In the stomach 50 per cent were diagnosed roentgenologically as benign tumors, 20 per cent as ulcers, and 20 per cent as malignant tumors. In the duodenum most were diagnosed as ulcers. At operation the differentiation from malignant growth may be impossible without frozen sections.

Treatment consists of excision but frequently more radical operations are performed because of uncertainty as to the diagnosis. When found incidentally at operation, the heterotopic tissue should be removed.

J. L. BOYER, M. D.

Heterotopic Pancreatic Tissue in the Region of the Pyloric Orifice. A Radiological and Pathological Analysis of Five Cases of Clinically Suspected Peptic Ulcer in Which Only Pancreatic Rests Were Found. Theo. R. Waugh and E. W. Harding. *Gastroenterology* 6: 417-435, May 1946.

In a series of 800 stomachs removed by subtotal gastrectomy in several hospitals over a period of six years, the authors found 5 cases in which aberrant pancreatic tissue was the only apparent pathologic condition to account for symptoms. In 4 instances the tissue was located in or very near the pylorus, in the fifth in the second portion of the duodenum. In none was there evidence of peptic ulcer at the time of operation.

A review of the literature and these 5 cases reveals a strikingly similar but not pathognomonic symptomatology. Often there is a rather long history of indefinite gradually increasing abdominal pain with slight tenderness in the epigastrium. Symptoms may or may not be relieved by food and alkalis. Loss of appetite, sour eructations, nausea and vomiting are likely to bring the patient to the physician. Hemorrhage with either hematemesis or the passing of blood in the stool has occurred in several cases. In 2 of the 5 cases presented here there was a history of hemorrhage from the upper alimentary tract. X ray findings are equivocal. Although no ulceration was found in the surgical specimens yet in 4 cases the pancreatic rest appeared to be responsible for some roentgenologic abnormality. In 2 cases adjacent spasm apparently caused focal deformity in the nature of an incisura to suggest ulceration. In none of the cases however was there an absolute and positive roentgen diagnosis of ulcer. The failure of a juxtapyloric lesion as seen roentgenologically to respond to medical treatment must suggest the possibility of a pancreatic rest.

There is no doubt that pancreatic rests can remain asymptomatic and there is some question as to the primary role they play in many of the cases. If they are congenital the fact that the majority of patients have no digestive disturbance and do not come to operation until adult life has to be explained. From the cases reviewed however it is obvious that heterotopic pancre-

atic tissue in the region of the pylorus can produce serious consequences in several different ways. First, and probably the most important of these, is actual interference with the passage of the stomach contents through the pyloric canal when the mass protrudes as a polypoid excrescence into the lumen. Second though there may be no actual stenosis, this tissue in the muscular wall can in all probability interfere with peristaltic activity. Third, a peptic ulcer may arise apparently from the discharge of pancreatic juice through a duct into its base. Fourth, even though an ulcer is not present, the possibility that the activity of the tissue or its excretion may cause functional disturbance has been raised and would have to be considered in one of the authors' cases. Finally benign and malignant neoplasms may arise from such aberrant tissue. This condition should be borne in mind in patients suspected of having peptic ulcer, neoplasm or cholecystitis, with atypical findings.

Calcified Gall Bladder. Albert Jutras and Marcel Longtin. *Canad. M. A. J.* 54: 434-437, May 1946.

Some gallbladders retain in their walls amounts of calcium and thus acquire unusual properties of roughness, color, and sound effect to percussion. In the diagnosis of these calcified gallbladders the roentgenologist plays the feature part, for he alone can demonstrate the lime infiltration without having to open the abdomen.

Kirklin, of the Mayo Clinic found calcified gallbladder in only 4 of a series of 5,826 cholecystectomies, and the present writers have made the diagnosis only 4 times in more than 6,000 cholecystographies performed since 1948.

Calcified gallbladders are usually large and of the hydropic type, occasionally they may be small, retracted and sclero-atrophic. On microscopic examination, the different coats of the normal organ are no longer recognizable. The mucosa is reduced to a few cellular traces, while the submucosa and muscularis are fused in one layer, greatly deprived of cells and invaded by hyaline substances, strongly acidophilic, giving a cartilaginous aspect.

Cholecystography with iodine preparations is usually valueless since the cystic canal is commonly obstructed and the mucosa always destroyed, rendering both penetration and concentration impossible. Moreover the richness in calcium permits spontaneous visualization on the flat film. The picture, in the hydropic form, is scarcely mistakable. The shadow has the shape, size, and location of the viscus whether ovoid, pyriform or round. In typical cases the calcium is distributed unevenly in a most distinctive form. The edge is dense and sharply defined, forming a shell 1 to 2 mm thick. This peripheral rim is due to a greater absorption of radiations in their course through the lateral portions. The ring is rarely closed, usually remaining open in some part of its upper pole, thus suggesting that calcification extends from bottom to top. Within the opaque margin the transparency is very irregular, the lime dispersion producing mottling or patches and giving at times a somewhat fish scale like aspect.

The sclero-atrophic type of calcified gallbladder is not easily differentiated. The general form of the viscus is less defined and the volume small. The incrustation is never intense, being unevenly distributed and causing streaky imprints.

HUGH A. O'NEILL, M. D.

THE SPLEEN

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Eleven cases are reported in detail. In 10 of the cases the ulcer was clean and healing at the time of onset of the bone disease. The first symptom was local pain mild in most instances and tenderness. Four cases ran an afebrile course, one patient had marked fever for five weeks, and in the others there was mild or moderate fever for varying periods. With a single exception constitutional symptoms were mild and there was no reddening of the skin or inflammatory edema locally. In no case was sequestrum and sinus formation suggested clinically. The average time required for complete clinical healing was twelve weeks.

Radiologically the first change was a decalcification in the cortex of the diaphysis of a long bone. Then followed linear periosteal new bone deposit the new bone having a fluffy or woolly appearance with a crenated outline. In some cases healing occurred by deposition of calcium salts in the new bone. In other cases changes indicative of osteomyelitis appeared before healing took place.

In 6 cases the bone lesion developed in a contralateral long bone. In 3 additional cases the lesions were multiple and occurred on both sides. The bones involved in order of frequency were the tibia, femur, fibula, radius and clavicle. The author has since seen 2 cases in which the shaft of the humerus was involved and so far the only long bones which have not been affected are the ulna and ribs. The ulcer sites in all the cases were on the leg anywhere between the knee and the ankle.

MAX CLIMAN M D

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The history is usually episodic, each succeeding episode being generally more severe than the preceding one. The author gives several reasons to account for the episodic nature of the symptoms. If the posterior longitudinal ligament is not torn but only thinned out ahead of the herniated disk, it is quite conceivable that the herniated disk may gradually return to its normal position with consequent remission of symptoms. A second injury will push the ligament posteriorly and symptoms will recur. In those cases where the posterior longitudinal ligament is actually torn and there is extrusion of disk material into the spinal canal, it seems possible that the herniated material may gradu-

ally work its way from one position to another in the canal, on one occasion producing exacerbation of the pain and on other occasions causing its remission. It is not likely that remission of symptoms can result from a return of the herniated disk to its normal position through a tear in the posterior longitudinal ligament. Another explanation for the episodic nature of the illness is that the spinal nerve on which the herniated disk impinges may slip to one side or the other of the herniated portion, with relief of symptoms. When the herniated mass moves once more and again impinges on the nerve, pain recurs. Finally it is known that continued pressure on a nerve will eventually cause it to cease to function. This may explain a few cases of gradual diminution in pain. With recurrent trauma, the herniated mass moves again, the pressure is increased, and symptoms reappear.

About half of the patients in this series gave a definite history of injury to the back preceding the attack. The other half had no specific history of injury but many of them stated that symptoms were first noticed after prolonged periods of heavy exertion such as military maneuvers or a period of hard manual labor.

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Sensory loss is one of the most dependable signs of a herniated disk. With herniations at L5 and S1 the most frequent sensory loss is over the lateral aspect of the leg, the dorsolateral and plantar aspect of the foot, and the lateral three or four toes. With herniations at L4 and L5, the most frequent sensory loss is over the medial portion of the dorsum and sole of the foot and over the dorsal and plantar surface of the great toe.

Atrophy resulting from disuse because of voluntary guarding of the limb and actual muscular atrophy due to temporary or permanent destruction of the motor nerve to the muscle may be determined by careful measurement of the limbs at parallel points. In advanced cases of herniated disk, definite motor weakness may be demonstrable.

There are no pathognomonic x-ray findings in the disk syndrome. Narrowing of the intervertebral space can usually be seen in both the anteroposterior and lateral views of the spine, but this is not a consistent finding nor does it always indicate the presence of a herniated disk. Loss of the normal lumbar lordosis may be evident in the lateral view. Pantopaque studies require careful interpretation. One must look for true defects in the column rather than long, smooth defects, which are most frequently artefacts. Swollen nerve roots may also cause a defect in the column of oil. They may be visualized occasionally as hour glass deformities, though these deformities may be due to central protrusion of the disk. In the more laterally placed herniation there may be no defect in the column of oil but the dural sleeve around the nerve root may be obliterated.

Orthopedic complications, such as spondylolisthesis, unstable lumbosacral articulations, and osteochondritis of the spine, may all be present. The possibility of fusing the lumbosacral articulation after removal of the herniated disk must be seriously considered when any of these complicating conditions is present.

All the cases of herniated disks in this series which were clinically and radiologically proved were treated surgically if the patient so desired. Of approximately 170 patients with herniated lower lumbar or lumbosacral disks seen since January 1945, 45 were operated on. In 30 cases the herniation was at L5 and S1, 12 were at L4 and L5, 2 were at both levels and 1 was at T7 and D1. In 33 cases there was immediate relief of radiating pain and gradual disappearance of low back pain. Six patients had immediate relief of radiating pain with persistence of mild low back pain. In 3 cases radiating pain improved but there was gradual complete return of the low back pain and in 2 cases the low back pain was possibly worse following surgery. In the high dorsal disk case there was complete relief of symptoms. The follow-up period is too short to be entirely significant but it is apparent that the radiating pain is cured much more regularly than is the low back pain.

BERNARD S. KALAJIAN, M.D.

Sideswipe Fractures. LaRue S. Highsmith and George S. Phalen. Arch Surg 52: 513-522 May 1946.

A sideswipe fracture is a mutilating comminuted fracture of the left elbow sustained when the driver of an automobile has the elbow projecting from the window at the time his car is sideswiped by an oncoming vehicle. There is usually extensive soft tissue damage with more or less avulsion of the posterior portion of the elbow. Associated damage to nerves and vessels makes this fracture difficult to treat and contributes to poor

results. Amputation through the lower end of the humerus (at the fracture level) is sometimes necessary. But since the function of a prosthesis is never as good as that of even a badly damaged hand, this measure should be avoided if possible. A rather conservative débridement with conservation of as much bone as possible followed by fixation at right angles offers the best outlook, but considerable individualization is necessary. Secondary arthrodesis or arthroplasty may be advisable, and in some instances a pseudarthrosis at the humeral fracture site has given a fairly good functional result. Internal fixation is seldom practical because of infection and the high degree of comminution.

Seven cases are reported and roentgenograms are reproduced. All the authors' patients were soldiers, but in every instance the injury was sustained while the patient was on furlough leave, or pass. The problem is therefore primarily a civilian one. The fracture could be largely prevented if the public were better informed as to its cause. LEWIS G. JACOBS, M.D.

Injuries of the Elbow in Children. George W. Chamberlin. Pennsylvania M. J. 49: 733-735 April 1946.

After the forearm, the most common site of fracture in childhood is around the elbow joint. In a series of 86 consecutive cases of elbow injuries in children it was found that supracondylar fractures were the most frequent. Separation of the median epicondyle of the humerus with or without dislocation of the bones of the humerus was second in order of occurrence.

Anatomically a child's elbow differs from that of an adult, and a knowledge of the time of appearance and fusion of secondary centers of ossification is important for a clear understanding of the mechanism which produces the various deformities following trauma. The cylindrical shaft of the humerus broadens, thus out and bends forward as it approaches the elbow. The olecranon and coronoid fossae also weaken it and make it less resistant to fracture. In children under nine years, a line bisecting the capitellum at right angles to its base makes an angle of about 45 degrees with a line bisecting the long axis of the humerus. In the anteroposterior view a line bisecting the long axis of the humerus will form a 10- to 15-degree 'carrying angle' with the long axis of the ulna.

The four secondary centers of ossification for the lower end of the humerus appear at the following ages: capitellum 11 months to 2 years; internal epicondyle 5 to 6 years; trochlea 9 years; external epicondyle 13 years. The capitellum, trochlea and external epicondyle fuse at about the 14th year and unite with the shaft at the 15th to the 17th year. Fusion of the internal epicondyle occurs a little later. The secondary center of ossification for the head of the radius appears at the 5th year and fuses about the 17th or 18th year.

In adults a fall on the hand with the forearm extended may result in a posterior dislocation at the elbow. The same force in a child is more likely to cause a supracondylar fracture of the humerus. The line of fracture is most often oblique from above downward and from behind forward just above the intracondylar line and through the olecranon fossa or foramen. The fragments may impinge upon the brachial artery or median nerve in the antecubital space.

Frequently there is associated with dislocation of the elbow in children a detachment of the median epicondylar epiphysis. The bony fragment of the epicondyle

may be easily overlooked within the joint space with resultant ulnar nerve paralysis and deformity. In 8 of the author's 9 patients with dislocation, separation of the median condyle occurred. In such cases an attempt at closed reduction should be made, as described by Schmeer (Surg, Gynec & Obst 80 416 1945 Abstr in Radiology 46 203, 1946), but in most instances open reduction is necessary.

Epiphyseal separation of the capitellum is not uncommon. It is frequently associated with fracture of the lateral condyle of the humerus. If the fragments are rotated the carrying angle will be increased.

JOSEPH T. DANZER, M.D.

Fractures of the Os Calcis J. C. Cherry Irish J. M. Sc. April 1946 pp 122-125

This paper on os calcis fractures illustrates well the value of a small series of cases with adequate follow-up. While the group studied actually numbers 7 cases (9 of a total of 16 cases having been excluded for various acceptable reasons) the uniformly poor results justify the author's criticisms, in so far as they demonstrate failure of the classical method of treatment (the Boehler technique) in the hands of an apparently very conscientious physician.

All of the patients were followed for at least four years and one for as long as nine years and all have some permanent partial disability—a stiff foot, usable but with pain and swelling at the end of a day's work.

The author believes that the reduction of the "salient angle," no matter how accurate is never maintained and that the end result in nearly all cases is the same as before treatment, and reproductions of films prove his point.

Certain drawbacks also attend the method: (1) the danger of sepsis when a pin is used for traction through the traumatized bone; (2) the frequent occurrence of osteoporosis, whether the result of disuse atrophy or heavy traction; (3) the severe wasting of the muscles. That the osteoporosis is not attributable to the original injury is indicated by its absence in cases in which a plaster cast is used and walking is permitted.

The author also goes into the financial aspects of the cases and their ultimate outcome, and clearly demonstrates that the compensation does not nearly meet the amount of disability.

SYDNEY F. THOMAS, M.D.

Diagnostic Problems in Fractures of the Foot and Ankle Daniel Wilner Am J Roentgenol 55 594-616 May 1946

The various areas of the foot are discussed in detail from the point of view of pitfalls in the diagnosis of fractures. Since the presentation is in almost outline form it is not easily abstracted, but some of the points made by the author may be noted.

In the metatarsus persistent epiphyseal lines and accessory bones must be differentiated from fractures. Accessory bones or ossicles are probably the most common source of confusion. A differential feature is the presence on every surface of the ossicle of cortex, while this will be absent from at least one surface of a fracture fragment. Since accessory bones are usually bilateral, examination of the opposite foot for comparison may be useful. Double or bipartite sesamoids are of quite frequent occurrence and special views may be required for their demonstration.

The os peroneum lies along the external border of the

cuboid bone. It varies greatly in size. It may be mistaken for a chip fracture of the os calcis or cuboid.

Isolated fractures of the scaphoid bone are rare. The os tibiale externum (accessory scaphoid), seen along the medial margin of the proximal articulating end of the scaphoid, is quite often mistaken for fracture. The talonavicular ossicle is uncommonly seen as a small fragment of bone on the dorsum of the foot between the upper edges of the astragalus and the scaphoid. It is difficult at times to differentiate from a chip fracture or a localized osteoarthritis.

Compression fractures of the astragalus are rare and hard to diagnose. In a profile view, a compression fracture may be confused with a normal low astragalus. The anterior superior portion of the astragalus may present a dorsal projection which may be fractured. The posterior projection of the astragalus may also be fractured, and such fractures must be distinguished from the os trigonum which may be present here as a separate center. Comparison with the opposite foot will be useful in differentiation. Osteochondritis dissecans, characterized by localized aseptic necrosis of cartilage and bone adjacent to it, has occurred in the astragalus and can be mistaken for fracture.

The os calcis is fractured more frequently than any of the tarsal bones. Lateral and superior inferior views are essential for diagnosis. Fracture of the sustentaculum is best visualized by an oblique view of the ankle in 45 degrees internal rotation. Spurs on the plantar surface of the os calcis may appear to be fractured when actually they are connected by fibrous tissue not visible on the roentgenogram. A small ossicle is sometimes present at the anterior superior extremity of the os calcis. This is also a frequent site of chip fracture.

Post-traumatic ossifications of torn ligaments at the lower end of the tibia must not be mistaken for avulsion fractures. Other sources of confusion are peri-articular deposits, calcifications in veins and arteries, and the os subtile, an accessory ossicle sometimes occurring below the internal malleolus.

A fracture of the lower end of the fibula may escape detection unless the ankle is angulated slightly to separate the fibula from the shadow of the tibia. Post-traumatic ossifications of the calcaneo-fibular ligament or the peronei tendons may occur below the lower end of the fibula a few weeks after injury.

Many drawings and roentgenograms are shown to illustrate the various accessory bones of the foot and the other abnormalities encountered in the foot and ankle.

CLARENCE E. WEAVER, M.D.

GYNECOLOGY AND OBSTETRICS

Some Interesting Observations in Routine Pregnancy Studies L. A. Fortier, T. T. Gately and P. A. Kibbe New Orleans M. & S. J. 98 456-458 April 1946

Since 1936 the authors have been doing x-ray pelvimetric studies by the method of Ball and Marchbank, to decide upon the feasibility of normal labor. They find that with the two films required with this method they can determine the type and size of the maternal pelvis, the presence of bone or joint lesions and relative to the fetus the number, position, size and probable term.

Reports are presented of one case of hydrocephalus, one case of anencephalic monster, and one case of spina bifida all demonstrated prenatally. In a fourth case

Sensory loss is one of the most dependable signs of a herniated disk. With herniations at L5 and S1 the most frequent sensory loss is over the lateral aspect of the leg, the dorsolateral and plantar aspect of the foot and the lateral three or four toes. With herniations at L4 and L5, the most frequent sensory loss is over the medial portion of the dorsum and sole of the foot and over the dorsal and plantar surface of the great toe.

Atrophy resulting from disuse because of voluntary guarding of the limb and actual muscular atrophy due to temporary or permanent destruction of the motor nerve to the muscle may be determined by careful measurement of the limbs at parallel points. In advanced cases of herniated disk, definite motor weakness may be demonstrable.

There are no pathognomonic x-ray findings in the disk syndrome. Narrowing of the intervertebral space can usually be seen in both the anteroposterior and lateral views of the spine, but this is not a consistent finding nor does it always indicate the presence of a herniated disk. Loss of the normal lumbar lordosis may be evident in the lateral view. Pantopaque studies require careful interpretation. One must look for true defects in the column rather than long, smooth defects, which are most frequently artefacts. Swollen nerve roots may also cause a defect in the column of oil. They may be visualized occasionally as hour glass deformities though these deformities may be due to central protrusion of the disk. In the more laterally placed herniation there may be no defect in the column of oil but the dural sleeve around the nerve root may be obliterated.

Orthopedic complications, such as spondylolisthesis, unstable lumbosacral articulations, and osteochondritis of the spine, may all be present. The possibility of fusing the lumbosacral articulation after removal of the herniated disk must be seriously considered when any of these complicating conditions is present.

All the cases of herniated disks in this series which were clinically and radiologically proved were treated surgically if the patient so desired. Of approximately 170 patients with herniated lower lumbar or lumbosacral disks, seen since January 1945, 45 were operated on. In 30 cases the herniation was at L5 and S1, 12 were at L4 and L5, 2 were at both levels and 1 was at T7 and D1. In 33 cases there was immediate relief of radiating pain and gradual disappearance of low back pain. Six patients had immediate relief of radiating pain with persistence of mild low back pain. In 3 cases radiating pain improved but there was gradual complete return of the low back pain and in 2 cases the low back pain was possibly worse following surgery. In the high dorsal disk case there was complete relief of symptoms. The follow up period is too short to be entirely significant but it is apparent that the radiating pain is cured much more regularly than is the low back pain.

BERNARD S. KALAYJIAN, M.D.

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results, amputation through the lower end of the humerus (at the fracture level) is sometimes necessary. But since the function of a prosthesis is never as good as that of even a badly damaged hand, this measure should be avoided if possible. A rather conservative débridement with conservation of as much bone as possible followed by fixation at right angles offers the best outlook, but considerable individualization is necessary. Secondary arthrodesis or arthroplasty may be advisable and in some instances a pseudarthrosis at the humeral fracture site has given a fairly good functional result. Internal fixation is seldom practical because of infection and the high degree of comminution.

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Injuries of the Elbow in Children. George W. Chamberlin. Pennsylvania M. J. 49: 733-735 April 1946.

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Anatomically a child's elbow differs from that of an adult, and a knowledge of the time of appearance and fusion of secondary centers of ossification is important for a clear understanding of the mechanism which produces the various deformities following trauma. The cylindrical shaft of the humerus broadens thus out, and bends forward as it approaches the elbow. The olecranon and coronoid fossae also weaken it and make it less resistant to fracture. In children under nine years a line bisecting the capitellum at right angles to its base makes an angle of about 45 degrees with a line bisecting the long axis of the humerus. In the anteroposterior view, a line bisecting the long axis of the humerus will form a 10- to 15 degree carrying angle with the long axis of the ulna.

The four secondary centers of ossification for the lower end of the humerus appear at the following ages: capitellum, 11 months to 2 years; internal epicondyle, 5 to 6 years; trochlea, 9 years; external epicondyle, 13 years. The capitellum, trochlea and external epicondyle fuse at about the 14th year and unite with the shaft at the 15th to the 17th year. Fusion of the internal epicondyle occurs a little later. The secondary center of ossification for the head of the radius appears at the 5th year and fuses about the 17th or 18th year.

In adults a fall on the hand with the forearm extended may result in a posterior dislocation at the elbow. The same force in a child is more likely to cause a supracondylar fracture of the humerus. The line of fracture is most often oblique from above downward and from behind forward just above the intracondylar line and through the olecranon fossa or foramen. The fragments may impinge upon the brachial artery or median nerve in the antecubital space.

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ureteropelvic juncture, or the ureter. Since aberrant vessels may be present without producing hydronephrosis, care must be taken not to overlook the true cause of the obstruction in such cases.

Stricture of the ureteropelvic junction was found in 3 cases. Most observers regard this as congenital in origin, but others believe that chronic inflammation of the ureter and ureteropelvic junction may produce the stenosis. Some cases are known to result from trauma.

Hypertrophy of the circular muscular layer of the ureter was found to be the cause of ureteropelvic obstruction in a single case. In 4 cases, fibrous bands produced obstruction. These are thought to be a residual of perinephritic infection, but may be associated with other etiological factors.

High insertion of the ureter was found in 10 cases, but this was believed to be the result of the hydronephrosis rather than the cause in most instances. Seven of these 10 kidneys were horseshoe kidneys and 3 were ectopic kidneys.

Pedunculated tumors of the pelvis or tumors near the ureteral orifice in the renal pelvis may cause obstruction in rare instances. Various combinations of the above named causes accounted for the obstruction in 6 of the author's cases. In many instances, only at operation was it possible to determine exact etiological factors.

The radiographic appearance may be quite characteristic in some instances. The renal pelvis is usually uniformly and symmetrically enlarged with the inferior border of the hydronephrotic sac smooth and even. The ureter is often not seen to enter the pelvis. When an aberrant vessel crosses the pelvis, a characteristic crescent-shaped deformity is produced by the presence of the opaque media in that portion of the pelvis distal to the obstructing vessel. When the vessel crosses the ureter distal to the ureteropelvic junction, the dilated ureter can be seen above the obstruction. Hypertrophy of the circular muscular layer of the upper ureter will usually produce a dilated renal pelvis which has not lost its normal funnel shape. Abnormally high insertion of the ureter can usually be determined, but is not commonly a factor in obstruction unless associated with other congenital anomalies. Lesions of the renal pelvis producing obstruction usually produce a filling defect in the pyelogram. **BERNARD S. KALAJIAN, M.D.**

Diagnosis of Perinephric Abscess. Lloyd G. Lewis. *S. Clin. North America* 26: 357-367, April 1946.

Correct evaluation of the history, physical signs, laboratory data, and x-ray findings should lead one to the diagnosis of perinephric abscess in the majority of instances. The diagnosis is often missed, however, because of sole reliance upon the radiologic picture not correlated with the symptoms and signs.

A large percentage of perirenal infections occur secondary to renal disease such as calculus, renal carbuncle, and pyonephrosis. Carbuncles, furuncles, or even superficial skin infections are frequently the source of infection when *Staphylococcus aureus* is the infectious agent. Colon bacilli may gain entrance to the kidney from the bowel by way of the lymphatics, but most frequently these organisms are found secondary to ureteral obstructions and calculus. *Streptococcus* abscesses may occur following dental tonsillar or sinus infections. The so-called non-pathogenic bacteria invade the kidney following retrograde cystoscopy, ureteral catheterization, and renal surgery.

The first symptoms noted are malaise and loss of appetite, usually accompanied by fever, which may be low grade or intermittent or when pyelonephritis is present, markedly elevated and spiking. Pain may be present but is not distinctive. Urological symptoms such as frequency, urgency, and dysuria are conspicuously absent unless the perinephric infections occur secondary to urolithiasis, pyelonephritis, or urological surgery.

Flexion of the thigh due to psoas spasm is a frequent physical finding. Signs referred to or from the diaphragm may be found. Costovertebral angle point-tenderness is usually present on the affected side. Urinalysis may be entirely negative and the urine may even be sterile to culture.

The roentgenogram may show curvature of the spine toward the affected side. The psoas muscle shadow may be obliterated, bulged outward, or of normal appearance. Pyelograms are most difficult to interpret. The diagnosis of a renal cortical tumor or renal cyst is frequently made because of distortion or obliteration of the calices. The kidney may be displaced or compressed. The only constant x-ray finding in perinephric abscess is fixation of the kidney, and for this reason upright films should be made in all suspected cases.

Six excellent illustrative cases are recorded in detail with fair illustrations. **SYDNEY F. THOMAS, M.D.**

Prostatic Calculi. Neil S. Moore and Earl A. Powell. *J. Missouri M. A.* 43: 245-248, April 1946.

From a study of the literature, the authors believe that prostatic calculi are more common than is generally believed. They are of two types: endogenous or true prostatic calculi and exogenous. Of the endogenous group, the most important are those occurring in pockets of an otherwise non-hypertrophic gland.

The etiology of endogenous calculi is unknown. The most generally accepted theory is that they begin with a nucleus of corpora amylacea, blood clot, clump of bacteria, epithelial debris, or pus upon which are deposited phosphate and carbonate salts. Exogenous prostatic calculi are formed outside the prostate, possibly as far distant as the kidney, and come to rest in the prostatic urethra.

Prostatic calculi may occur at almost any age, but the majority are found in the fourth, fifth, and sixth decades. They may be discovered incidentally in association with almost any prostatic disease, having given no clinical evidence of their presence. It is the authors' opinion that calculi appearing in a carcinomatous prostate are purely coincidental and not necessarily an etiologic factor. Endogenous prostatic calculi vary in size from a mustard seed to 2 cm. in diameter and in number from a few to many hundred. Sooner or later their presence will set up an inflammatory process in the gland.

Though some cases are symptomless, in others symptoms are present, varying from slight local irritation and urinary disturbance up to abscess formation with chills and fever and pain in the rectum or perineum. The commonest symptoms are dysuria and sometimes a urethral discharge which on examination reveals only pus cells.

The diagnosis may be suspected on rectal examination or on the passage of instruments into the posterior urethra, which will produce severe pain. Positive diag-

there was poor visualization of the fetal bones in repeated examinations during the course of pregnancy which phenomenon was found at delivery to be due to osteogenesis imperfecta

BERNARD S KALAYJIAN, M D

Value of Antenatal Radiological Pelvimetry (A Comparative Survey of the Prediction and Event in 300 Successive Pelvimetric Studies at Queen Charlotte's Maternity Hospital) E Rohan Williams and Leonard G Phillips J Obst & Gynec Brit Emp 53 125-139, April 1946

This paper is an attempt to assess the reliability of prediction of the course of labor from antenatal radiological examination alone. It is based upon a study of 300 pelvimetric cases, with a careful follow up study in each instance.

Forty nine patients were delivered by cesarean section in 42 of these, the prediction could not be tested. Ten of the 49 patients had had previous cesarean section. Of the 222 patients delivered without any manifestation of disproportion, 200 (90 per cent) were predicted as likely to have delivery without disproportion. In 51 of 54 cases (94.4 per cent) in which there was abnormal delivery due to disproportion, the prediction was abnormal or difficult delivery. In the entire series of 300 cases the prediction was wholly correct in 83 per cent of the 253 assessable cases and substantially correct in 90.11 per cent, the difference between "wholly correct" and "substantially correct" being explained by the inclusion in the substantially correct figures of those cases with forceps aided deliveries but without signs of disproportion during labor. The predictions which proved erroneous were, almost without exception unduly pessimistic and therefore did not lead to obstetric tragedy but rather ensured added watchfulness in patients whose pelvis could not be regarded as functionally ideal in shape or in size qualitatively or quantitatively, for childbearing.

Roentgen Diagnosis of Placenta Praevia Without Contrast Material Vincent W Archer and Norman Adair South M J 39 297-301, April 1946

The authors use the method of Ball and Golden (Am J Obst & Gynec 42 530, 1941) for the demonstration of placenta praevia. Roentgenograms of the pelvis are made in the anteroposterior and lateral positions with the patient standing, especial care being taken to avoid rotation in either view. Fourteen by seventeen inch films are used with the Potter-Bucky diaphragm and 40 mm Al filter. For the lateral view, the central rays are directed through the superior border of the acetabulum. For the anteroposterior view the patient stands with her back against the x-ray table, the position of the tube is not changed.

With vertex presentations the head is normally in the mid line in both the lateral and the anteroposterior view dropping slightly below a line between the promontory of the sacrum and the upper border of the symphysis in the last ten or twelve weeks of gestation. In the experience of the authors, placenta praevia is definitely eliminated by such a picture. If however there is deviation of the head from the mid line in either view or failure of the head to dip into the pelvis as the pregnancy advances some type of pelvic mass is indicated.

Four illustrative cases are recorded. In the first, the

head was above the promontory-symphysis line and displaced posteriorly in the lateral view though it lay in the mid line in the anteroposterior film. The roentgen diagnosis of placenta praevia was proved at operation—low cesarean section. In the second case, because of severe bleeding, only an anteroposterior view was obtained. This showed a marked deviation of the head laterally. Placenta praevia was proved at cesarean section. In the third case there was lateral and anterior displacement of the head, but it dipped below the promontory symphysis line. A roentgen diagnosis of marginal placenta praevia was made. A Braxton Hicks version was done and a macerated fetus was delivered by breech extraction. The fourth patient was examined with an opaque medium in the bladder. The fetal head was shown to be displaced laterally and anteriorly and it did not dip into the pelvis. A roentgen diagnosis of placenta praevia was made. Thirty-seven hours later a dead fetus was delivered spontaneously.

The authors conclude that the position of the placenta within the pelvis can be accurately determined by the simple non instrumental technique described but that the indications for cesarean section remain a clinical problem. Their opinion is that with failure of the head to dip below the promontory symphysis line, labor will be difficult in the majority of instances and the possibility of a viable fetus quite remote. Cesarean section would therefore seem to be indicated under these conditions.

BERNARD S KALAYJIAN, M D

THE GENITO-URINARY SYSTEM

Urography on Children After Administration of the Contrast Substance by Mouth Aage Friese-Christiansen Acta radiol 27 197-201, March 30, 1946 (In English)

Because of the well known difficulties of intravenous urography in infants and small children, the author uses oral administration of hippodrin (hippuran). Preparation is as for other methods and dosage is 10 gm. for children under ten years of age and 15 gm for those over ten. The optimum time interval before roentgenographic examination has been found to be three to four hours. Shorter intervals add difficulty in interpretation because of contrast medium in the intestine. Of the 16 reported examinations satisfactory roentgenograms were obtained in 10. In none of the cases was nausea or vomiting encountered the only difficulty being the disagreeable taste of the drug.

ELIZABETH A CLARK, M D

Recognition of Ureteropelvic Obstruction. Donald M Beard J M A Georgia 35 107-111 April 1946

Determination of the exact cause of ureteropelvic obstruction producing hydronephrosis may not be possible from pyelographic studies alone though the hydronephrosis itself is easily recognized. The author reviews 51 cases of ureteropelvic obstruction studied in an Army general hospital. The most frequent etiological factor was aberrant or accessory renal vessels—27 cases. This incidence is higher than commonly reported and probably is related to the relative youth of the patients. These vessels usually supply a small area of the lower pole and may arise from the aorta or the main renal vessels. The pulsations of the vessels are thought to interfere with the peristalsis of the ureter, producing the obstruction. The vessel may cross the pelvis the

ularly informative. Other
ate for determining the iden-
tation

angiography is probably most
fistulae, whether acquired or
monstrates the usefulness of
ming the patency of arterial
rafts with vitallium cuffs

oned briefly. The author is not
ises of acute thrombophlebitis or
in extremities. He finds it most
the adequacy of the deep venous
phlebitis cases involving the lower
tractor feels that venography is
value except in cases where the
ests are masked by some overlying
ed soft-tissue damage by ulceration
na. In review of over 50 veno-
munity, and 5 of the arm, so little
as gathered that the procedure

has been used less and less. Homan, an early advocate
of venography, states that results of the procedure
have been mercifully "disappointing" (New England
J Med 231:51, 1944). | SYDNEY F. THOMAS, M.D.

An Improved Method of Arthrography. A. Blaus-
tein. Canad M A J 54:491-492, May 1946.

The author has devised a simple apparatus for
arthrography of the knee joint. It consists of a mini-
ature oxygen tank with an airflow control gauge at-
tached, a 100-cc syringe and a 3-way stopcock, a glass
filter, and some rubber tubing, assembled on a portable
wooden stand. The apparatus delivers a controlled
measured amount of filtered pure oxygen into the knee
joint.

For routine arthrography of the knee, anteroposterior
and lateral films are made, also an anteroposterior
film over a curved cassette with the knee flexed 30 de-
grees, and spot films on either side of the patella.

MOHRIS IVKAR, M.D.

RADIOTHERAPY

the Cases
1944 In-
of ulz

Except for Wilms tumor, neoplasms of the kidney do
not respond to irradiation, and no evidence was ob-
tained of any superiority of supervoltage therapy in
this group. The earlier results of supervoltage irradiation
in carcinoma of the bladder at the authors' clinic
have been reported previously (Radiology 41:371,
1943). The former dose of 5,000 r has now been re-
duced to 3,000 r at the site of the tumor. The maxi-
mum tolerance dose to the bladder and rectum seems to
be between the two figures. No post irradiation struc-
tures occurred. Observations on 100 cases seem to
show that supervoltage irradiation is an excellent palli-
ative measure, that it prolongs life, and that in a small
percentage of cases it results in permanent cure.

From 1935 to 1941, supervoltage radiation of car-
cinoma of the cervix was given through three fields, one
anterior and two posterior, 3,000 r, measured in air,
being given to each. The daily dose was 100 r, the
estimated dose at the site of the tumor was 5,000 r.
Subsequently only two fields were used, the total dose
each was 3,000 r, but the daily dose was reduced to
50 r. The estimated dose at the site of the tumor was
3,000 r. All cases received radium as well as roentgen
treatment, the dosage being between 3,000 and 5,000
hr. Comparison of life expectancy in carcinoma of

the cervix receiving supervoltage irradiation with those
with 200 kv radiation shows a definite increase
percentage surviving more than one year with the
supervoltage. After five years the two curves begin
to parallel. There was an absence of severe skin
reactions and a decrease in roentgen sickness.

One of the most important advantages of supervolt-
age radiation is the lower incidence of serious skin dam-
age. The authors believe that when the cases are prop-
erly selected, supervoltage radiation offers the patient a
but definite, increase in life expectancy and that
the unavoidable bad effects of irradiation with
200 kv radiation can be eliminated. The use of super-
voltage radiation should be encouraged in carcinoma of
the cervix, carcinoma of the bladder, carcinoma of the
embryoma of the testicle, carcinoma of the tonsil
and lymphoma, Ewing's tumor, and carcinoma of the
rectum.

CHARLES L. WHAVER, M.D.

nosis is dependent on roentgen examination. The ordinary roentgenogram made with the tube over the mid part of the abdomen will throw the shadow of the prostate beneath the symphysis pubis and may thus obscure any calculi present. If the patient is placed on the table with a pillow under the dorsal vertebrae and the rays are directed down the pelvic strait the prostatic shadow will fall within the pelvic cavity and calculi will be easily recognized.

Treatment depends upon the severity of the symptoms and the age of the patient. If the symptoms are mild, occasional irrigation and perineal heat will be sufficient. A prostate filled with stones should not be massaged, as such treatment merely grinds the calcareous deposits around in the gland causing further irritation. If the symptoms are severe and obstructive signs are present the gland may be removed completely. If the patient is young and there is no sign of obstruction, a suprapubic or perineal prostatolithotomy may be done. Transurethral resection is a useful procedure in cases in which a stone may be pocketed in the median or lateral lobes near the urethral mucosa.

Six case histories are recorded.

BERNARD S. KALAJIAN, M.D.

THE BLOOD VESSELS

The Innervation of the Veins. Its Role in Pain, Venospasm, and Collateral Circulation. A. de Sousa Pereira. *Surgery* 19 731-742 May 1946.

Investigations have shown that the nerves of the veins, arteries, and lymphatic vessels are responsible for much of the pain in cancer. It is also known that denervation of both arteries and veins is followed by cessation of all sensation of pain and by dilatation of the vessels. There is a more rapid and extensive development of collateral circulation in all three types of vessels following denervation.

This communication, in addition to reviewing the literature reports further work directed toward clarifying the pathways taken by the afferent and efferent vasomotor nerves in supplying the peripheral veins. Some difference of opinion exists as to whether there is termination of pain fibers in both the adventitia and the intima of the veins. Mechanical or chemical stimulation of the adventitia of the femoral vein was found to induce a diffuse pain that could be relieved either by anesthetizing the outer layer just above the point of stimulation or by anesthetic blocking of the lumbar sympathetic chain. Irritation of the intima of the femoral vein also induced pain and intraluminal injection of one per cent novocaine solution abolished pain in thrombophlebitis thus showing that there are pain fibers in both adventitia and intima. These experiments form the basis for the conclusion that both afferent and efferent fibers reach the peripheral veins and pass through the sympathetic chain in doing so.

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then obtained by a sympathetic block at the level of the third lumbar ganglion. In the case of thrombophlebitis, venograms failed to show any part of the saphenous in the leg. Two hours after blocking the third lumbar sympathetic ganglion with novocaine a repeat venogram visualized the vein in the lower two thirds of the leg, the upper third was still obliterated, but there was increase in the development of collateral venous circulation. Twelve minutes after the sympathetic block pain disappeared and was absent for twenty four hours. Slight recurrence of pain was relieved by a second anesthetic block of the sympathetic chain. Since the venous vasodilatation and the relief from pain lasted for a longer period than the action of the anesthetic it seems logical to conclude that in these cases venospasm played a role in the mechanism of pain arising in the veins. These investigations show that interruption of the sympathetic chain relieves the pain in phlebitis and thrombophlebitis.

The author also showed that repeated anesthetic blocks of the lumbar sympathetic chain (second third and fourth lumbar nerves) in phlebitis and thrombophlebitis lead to dilatation of the veins of the legs, and to improvement in the collateral venous circulation. In 2 other patients with thrombophlebitis he showed that perivenous sympathectomy of the femoral vein results in relief of pain and amelioration of vasomotor disturbances. There was also an increase in the collateral venous circulation. In a third series resection of the third and fourth lumbar sympathetic ganglia and trunk was done. A manifest improvement in the existing thrombophlebitis and increase in the collateral circulation of the lower limbs followed the operation in each of two patients.

Clear reproductions of venograms are included.

J. E. WHITELEATHER, M.D.

Angiography—An Evaluation of Its Usefulness. A. H. Blakemore. *S. Clin. North America* 26 326-342 April 1946.

Technics have been evolved making the safety of angiography in any region entirely commensurate with its diagnostic importance in given instances. Thus while cerebral angiography should not be employed on the slightest provocation it is possible when there is a serious doubt as to diagnosis to visualize the cerebral vessels with safety to rule out for example, the presence of an arterial aneurysm or to localize a traumatic arteriovenous fistula.

Aortography according to the technic of Robb and Steinberg in which 70 per cent diodrast is introduced into a vein in the right arm gives a high degree of precision in the diagnosis of cardiovascular disease. A film obtained by this method in a case of the tetralogy of Fallot is reproduced. Retrograde opacification of the aorta by way of the right common carotid or right brachial artery will demonstrate an aneurysm or patent ductus. dos Santos and his associates inject a contrast medium directly into the ascending aorta. The author found this method useful in checking the degree of clotting in aneurysms when employing the electrothermic method of coagulation. He shows good examples of the procedure.

Warning concerning the use of arteriography for revealing the adequacy of collateral branches around areas of obstruction is given. Arteriography for this purpose is not only dangerous but because of the superimposed

vasospasm, is not particularly informative. Other methods are equally accurate for determining the adequacy of collateral circulation.

The author feels that angiography is probably most useful in arteriovenous fistulae, whether acquired or congenital. He also demonstrates the usefulness of angiography in determining the patency of arterial anastomoses with vein grafts with vitalium cuffs.

Venography is mentioned briefly. The author is not in favor of using it in cases of acute thrombophlebitis or phlebothrombosis in the extremities. He finds it most useful in determining the adequacy of the deep venous system in old post-phlebitis cases involving the lower extremity. [The abstractor feels that venography is of little additional value, except in cases where the clinical circulatory tests are masked by some overlying skin changes or marked soft-tissue damage by ulceration and surrounding edema. In review of over 50 venograms of the lower extremity, and 5 of the arm, so little additional information was gathered that the procedure

has been used less and less. Homans, an early advocate of venography, states that results of the procedure have been increasingly "disappointing" (New England J Med 231:51, 1944).] SYDNEY F. THOMAS, M.D.

An Improved Method of Arthrography A. Blaustein. *Canad. M. A. J.* 54:491-492, May 1946.

The author has devised a simple apparatus for arthrography of the knee joint. It consists of a miniature oxygen tank with an airflow control gauge attached, a 100 c.c. syringe and a 3-way stopcock, a glass filter and some rubber tubing, assembled on a portable wooden stand. The apparatus delivers a controlled measured amount of filtered, pure oxygen into the knee joint.

For routine arthrography of the knee, anteroposterior and lateral films are made, also an anteroposterior film over a curved cassette with the knee flexed 30 degrees, and spot films on either side of the patella.

MORRIS IVKER, M.D.

RADIOTHERAPY

NEOPLASMS

Supervoltage Radiation: Review of the Cases Treated During an Eight Year Period (1937-1944 Inclusive) George W. Holmes and Milford D. Schulz. *Am. J. Roentgenol.* 55:533-554, May 1946.

During the eight-year period covered by this report a total of 1,835 cases were treated by supervoltage irradiation (1,200 kv). The generator was of the Van de Graaff constant potential type. The output of this generator at 1,200 kv and 0.5 ma, with filtration of 2 mm lead, 5 mm copper, and 2 mm aluminum, is 45 r per minute, measured in air at 70 cm distance. The depth dose at 10 cm below the surface, with a field of 100 sq cm, is about 52 per cent of the surface dose. A dose of 3,000 r at that depth can be administered through two opposing portals at a daily rate of 300 r, without producing more than a mild erythema.

In carcinoma of the tonsils, supervoltage therapy gave somewhat better results than irradiation at 200 kv, and it was felt that there was an added advantage in that the dose could be delivered through a single lateral field without significant skin damage and with less discomfort to the patient. A similar advantage may exist in laryngeal cancer, though the results in the present small series were approximately the same as with 200 kv. In cancer of the oral cavity, nasopharynx and accessory sinuses also, the survival rate was about the same as with the lower voltage.

In carcinoma of the lung, supervoltage radiation was found to be worth while for palliation and in a fair percentage of cases life was prolonged. The oat-cell carcinomas showed the best percentile survival. In other types surgical treatment is recommended where there is a chance of cure.

In carcinoma of the esophagus there was no evidence that supervoltage radiation increased the survival time over the older methods, nor was any permanent benefit effected in carcinoma of the stomach. In carcinoma of the rectum it is believed that a better selection of cases with a tumor dose up to 5,000 r would result in some five year cures and in some cases might obviate the necessity for colostomy.

Except for Wilms tumor, neoplasms of the kidney do not respond to irradiation, and no evidence was obtained of any superiority of supervoltage therapy in this group. The earlier results of supervoltage irradiation in carcinoma of the bladder at the authors' clinic have been reported previously (*Radiology* 41:371, 1943). The former dose of 5,000 r has now been reduced to 3,000 r at the site of the tumor. The maximum tolerance dose to the bladder and rectum seems to be between the two figures. No post irradiation strictures occurred. Observations on 196 cases seem to show that supervoltage irradiation is an excellent palliative measure, that it prolongs life and that in a small percentage of cases it results in permanent cure.

From 1938 to 1941, supervoltage radiation of carcinoma of the cervix was given through three fields, one anterior and two posterior, 3,000 r, measured in air, being given to each. The daily dose was 400 r, the estimated dose at the site of the tumor was 5,000 r. Subsequently, only two fields were used, the total dose to each was 3,000 r, but the daily dose was reduced to 300 r. The estimated dose at the site of the tumor was 3,000 r. All cases received radium as well as roentgen treatment, the dosage being between 3,000 and 5,000 mg hr. Comparison of life expectancy in carcinoma of the cervix receiving supervoltage irradiation with those treated with 200 kv radiation shows a definite increase in percentage surviving more than one year with the higher voltage. After five years the two curves begin to run parallel. There was an absence of severe skin damage and a decrease in roentgen sickness.

Perhaps the most important advantage of supervoltage radiation is the lower incidence of serious skin damage. The authors believe that when the cases are properly selected, supervoltage radiation offers the patient a slight but definite increase in life expectancy and that some of the unavoidable bad effects of irradiation with lower voltage can be eliminated. The use of supervoltage radiation should be encouraged in carcinoma of the cervix, carcinoma of the bladder, carcinoma of the lung, embryoma of the testicle, carcinoma of the tonsil, localized lymphoma, Ewing's tumor and carcinoma of the rectum.

CLARENCE E. WEAVER, M.D.

nosis is dependent on roentgen examination. The ordinary roentgenogram made with the tube over the mid part of the abdomen will throw the shadow of the prostate beneath the symphysis pubis and may thus obscure any calculi present. If the patient is placed on the table with a pillow under the dorsal vertebrae, and the rays are directed down the pelvic strait, the prostatic shadow will fall within the pelvic cavity and calculi will be easily recognized.

Treatment depends upon the severity of the symptoms and the age of the patient. If the symptoms are mild, occasional irrigation and perineal heat will be sufficient. A prostate filled with stones should not be massaged, as such treatment merely grinds the calcareous deposits around in the gland, causing further irritation. If the symptoms are severe, and obstructive signs are present, the gland may be removed completely. If the patient is young and there is no sign of obstruction a suprapubic or perineal prostatolithotomy may be done. Transurethral resection is a useful procedure in cases in which a stone may be pocketed in the median or lateral lobes near the urethral mucosa.

Six case histories are recorded.

BERNARD S. KALAYJIAN, M.D.

THE BLOOD VESSELS

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cent supraclavicular, 13 per cent inguinal, and 8 per cent osseous (rib and femur) For the discovery of metastatic lesions, particular reliance is put on frequent roentgen examination of the chest and urinary tract Excretory urographic studies are extremely valuable in revealing retroperitoneal deposits

At present it is generally conceded that all patients with malignant testicular tumors should have the benefit of irradiation and orchiectomy The following technical factors are considered as constituting "conventional" treatment during the period of this report 190 or 200 kv, 0.5 mm Cu or 1 mm Cu plus 1 mm Al filtration 50 cm or 80 cm target-skin distance, the total dosage being at least 800 r in air applied to the mid-abdomen either anteriorly or posteriorly and extending 10 cm to each side of the mid-line In more recent cases as much as 1,600 r was given to abdominal fields anteriorly and posteriorly and in some, the mediastinal and left supraclavicular regions were also included In patients receiving preoperative irradiation, at least 1,000 r delivered to the testis is considered "conventional" In those patients free from demonstrable metastases on admission and receiving conventional therapy no statistically significant difference can be demonstrated in the five-year survival of patients with homologous and heterologous tumors The most important factors in survival appear to be the histopathologic classification of the tumor, the presence or absence of metastases, and well planned radiotherapy

In the absence of clinical metastases treatment is given to fields planned so that the lymphatic drainage channels of the torso on either side of the mid line of the body from the supraclavicular regions to the symphysis pubis and the inguinal regions and pelvis are irradiated The irradiation is started in the peripheral fields When treatment of all the fields has been completed they are again treated in the same order Each field should receive a total dose of 1,600 r in air If treatment is to be applied to the primary tumor, it should not be started until all of the other fields have received at least 1,000 r Operation can be carried out at any time following completion of the roentgen therapy either immediately or after a delay of a few days to three weeks Simple orchiectomy is preferred If the patient has clinical evidence of metastases irradiation should be carried to the limit of skin tolerance in that area If postoperative therapy is the method of choice treatment should be given over the primary drainage areas first, followed by successive fields upward to include finally the left supraclavicular area and downward to include the inguinal regions and pelvis

In this series of 43 patients the over all five year survival rate was 42 per cent In those without metastases the rate was 71 per cent and in those with metastases on admission it was 30 per cent No difference in end results was demonstrated between preoperative and postoperative irradiation This observation, the authors point out is at variance with that in an earlier report which included a considerable number of cases in the present series (Am J Roentgenol 46 850 1941 Abstr in Radiology 39 123 1942) At that time preoperative irradiation was believed to offer the greater opportunity of cure It is now recommended that all patients with a malignant tumor of the testis should receive preoperative or immediate postoperative irradiation regardless of the presence or absence of evidence of metastases CLARENCE E WEAVER, M D

NON-NEOPLASTIC DISEASE

Treatment of Tinea Capitis with Roentgen Rays. George M MacKee, Arthur Mutscheller, and Anthony C Cipollaro Arch Dermat & Syph 53 458-465, May 1946

There is a nationwide epidemic of tinea capitis in the United States No one knows the exact number of cases, but it has been estimated that there are over 5,000 in New York City alone This epidemic has offered an opportunity to study the different methods of applying an epilation dose of x-ray to the scalp

The Adamson-Kienboeck five-point method has been used for years and has stood the test of time In some European dermatologic centers, however, three four, and even seven points of irradiation are used The chief criticism of the Adamson-Kienboeck method is that there is overlapping, so that some areas receive an x ray dose almost double that of the center In spite of this permanent epilation has occurred in only a small number of cases It is the opinion of the authors that the cause in these cases is probably to be found in improperly calibrated apparatus or faulty technique They still prefer the five-point technique, though they describe a four point epilation method which they have evolved

In the authors' four point method, a line is drawn from the anterior to the posterior hair line in the sagittal plane, the distance is bisected and marked with a skin pencil Another line is drawn from one ear through the center point to the other ear The patient is placed in a supine position and the head is rotated 90 degrees A pointer 25 cm in length is placed in the filter slot of the machine and centered midway between the ear and the apex of the scalp A tongue blade is placed at the center point of the scalp pointing upward, and the tube is angled until the tongue blade bisects the pointer at the 12.5 cm mark The ear is bent forward and 300 r is given to the area, using 60 to 100 kv no filter The same technique is used for the other three areas

Seventy five patients who had tinea capitis caused by *Microsporum audouinii* were treated by this method Almost all of them were cured in from four to eight weeks The importance of the use of the adhesive cap and appropriate post epilation treatment is mentioned

While localized epilation is successful in some cases, the authors do not advocate it In the event of failure, it is unsafe to apply a second epilating dose in less than six months

JOSEPH T DANZER, M D

Irradiation for the Elimination of Nasopharyngeal Lymphoid Tissue Donald F Proctor Arch Otolaryng 43 473-480 May 1946

At the Hagerstown Clinic for the Prevention of Deafness in Children (described in a paper in the same issue of Arch Otolaryng pp 462-472) irradiation of nasopharyngeal lymphoid tissue was carried out in 323 patients (981 treatments) Many of the patients had not finished their treatments at the time of the report, but 100 had complete eradication of nasopharyngeal lymphoid tissue and 144 patients had satisfactory regression of such tissue with clearing of the eustachian orifices Ten patients showed no improvement but only 2 of these had received more than two treatments

Since irradiation produces its effects only over relatively long periods, it is difficult to evaluate results of therapy in a clinic which has been in existence only a little over two years However, 19 patients with recur-

Cancer of the Cervix A New Technique for Interstitial Implantation of Radium into the Parametrium. E Eugene Covington Surg., Gynec & Obst 82 512-517, May 1946

The author describes his method of interstitial implantation of radium into the parametrium in cancer of the cervix. He has used this additional irradiation in 100 cases and believes preliminary results are better than with intracavitary radium and external roentgen therapy alone, which furnish only a negligible amount of radiation to the pelvic nodes. His method increases the dose delivered to the cervix and considerably increases the dose to the parametria and lymph nodes.

The first radium treatment of 3 600 mg hr is divided into 2 160 mg hr by tandem in the uterine canal and 720 mg hr into each lateral vaginal fornix. Roentgen therapy (400 kv) is started a few days later—2,000 to 2 400 r to each of four pelvic fields over a four week period, for a tumor dose (at 10 cm) of 3 360 r. As soon as the roentgen series is completed interstitial radium therapy by the new technique is instituted. Four small incisions are made as far laterally as possible just through the vaginal mucosa, at the 2, 4, 8 and 10 o'clock positions around the cervix. A long Kelly clamp is then used to extend a long tract (2 to 4 cm) into the parametria through each of the four incisions. Two rubber tandems containing 25 mg of radium and two containing 20 mg of radium are used one in each tract. At the same time a long intrauterine tandem containing 60 mg is inserted in the uterine canal. These are all left in twenty eight hours. This gives a second dose of 1,680 mg hr to the uterine canal and 1,260 mg hr into each parametrium. The total irradiation directly to the cervix is thus increased, the distribution of radiation is more uniform and, especially important, the dose to the parametria and pelvic lymph nodes is increased.

The author says that the insertion of the Kelly clamp to make the tracts into the parametria requires practice but in his experience no immediate complications have arisen. He practised on cadavers before attempting the procedure in a patient. This method of insertion he regards as safer than the use of parametrial radium needles, and moreover the heavier filtration (1 mm Pt + 2 mm rubber) decreases the tendency to necrosis where needles are used. The method is applicable in stages I, II and III carcinoma of the cervix, its use in stage IV is dangerous and unwarranted. Other contraindications are fibrosis following the earlier treatment, and infection. JOHN A COCKE M.D.

Tumor of the Testicle Analysis of One Hundred Cases A Preliminary Report. E C Lowry D E Beard, L W Hewitt and J L Barner J Urol 55 373-384, April 1946

This is a preliminary report of 100 cases of tumor of the testicle. The patients were all soldiers treated at an Army General Hospital for a period varying from thirty to ninety days, and each case was subjected to a careful and thorough investigation. The tumors were classified as: benign teratoma (adult tissue only) 1, teratoma of mixed type, 24, embryonal carcinoma (without adult elements), 27, seminoma (without adult elements), 24, adenocarcinoma (without adult elements), 21, rhabdomyosarcoma, 1, fibroma, 1. One tumor was unclassified.

The method of treatment was the same in general

for all 100 cases, i.e., orchectomy after the technique described by Dodson (Urological Surgery C V Mosby Co 1944, pp 659-682) followed by deep x ray therapy. Irradiation was generally started as soon as the patient could be transported to the x ray department as a rule three to five days postoperatively. All treatments were given with the following factors: 200 kv (GE Maxumac) 15 ma 50 cm target skin distance, 0.5 to 1.0 mm Cu and 1.0 mm Al filter added (half value layer 0.9 to 1.35 Cu) 42 to 31 r per minute measured in air. The plan of x ray therapy depended upon (1) the presence of metastases before treatment or a duration of symptoms for six months or longer (2) no metastases at any time and a duration of symptoms of six months or less. Diagrams showing the portals of treatment for the two plans are reproduced. In both 2 ports were treated daily, in rotation each receiving 200 to 250 r (air dose) until 1,600 to 2,000 r (air dose) were delivered to each field. Fields were marked with indelible dye to facilitate setting up the case and to prevent overlapping. Adjacent fields were shielded with lead plates to avoid excessive irradiation. The umbilicus was protected with a small lead button during the latter half of the treatment to this area. The penis and normal testicle were pulled to the opposite side in all cases when the inguinal region was treated.

Twenty four patients upon admission had definite demonstrable metastases and in 2 other cases metastases developed during the stay in the hospital. Subsequent examination revealed metastases in 12 additional cases. In only a few of the cases with metastases did x ray therapy produce an appreciable diminution in size or disappearance of the metastatic mass. In those cases which responded initially there was subsequent recurrence. Several cases showed definite advancement of the disease during the course of treatment. Fourteen patients in this group were dead at the time of the report, and an additional 8 were bedridden and dying from the disease.

Of the entire group of 100 patients, 68 were living and well at the time of the report without evidence of metastasis. The length of time that had elapsed since operation in these cases varied from a few weeks to three years. While x ray therapy appears to have little if any actual curative value in cases where metastases have already occurred the authors believe in giving these patients the benefit of the doubt for the palliative effects of x ray and in some cases an apparent prolongation of life.

Management of Malignant Tumors of the Testis. Eugene P Pendergrass George W Chamberlin Joseph Selman and Robert C Horn Jr Am J Roentgenol 55 555-574 May 1946

This study is based on 43 patients all of whom are definitely known to have had malignant tumors of the testis. Among these were 20 homologous tumors (18 seminomas and 2 embryonal carcinomas) and 15 heterologous tumors (13 malignant teratomas and 2 adult teratomas). Seventy four per cent of all the malignant testicular tumors occurred between the ages of twenty and thirty nine. Experience has shown that lumbar pain is a symptom of ominous significance. In 58 per cent of all the patients there was evidence of metastasis at some time during their illness. 80 per cent of those with metastases had retroperitoneal involvement, 54 per cent mediastinopulmonary 25 per

cent supraclavicular, 13 per cent inguinal, and 8 per cent osseous (rib and femur). For the discovery of metastatic lesions, particular reliance is put on frequent roentgen examination of the chest and urinary tract. Excretory urographic studies are extremely valuable in revealing retroperitoneal deposits.

At present it is generally conceded that all patients with malignant testicular tumors should have the benefit of irradiation and orchiectomy. The following technical factors are considered as constituting conventional treatment during the period of this report: 190 or 200 kv, 0.5 mm Cu or 1 mm Cu plus 1 mm Al filtration, 50 cm or 80 cm target-skin distance, the total dosage being at least 800 r in air applied to the mid-abdomen either anteriorly or posteriorly and extending 10 cm to each side of the mid-line. In more recent cases, as much as 1,600 r was given to abdominal fields anteriorly and posteriorly, and in some, the mediastinal and left supraclavicular regions were also included. In patients receiving preoperative irradiation at least 1,000 r delivered to the testis is considered conventional. In those patients free from demonstrable metastases on admission and receiving conventional therapy no statistically significant difference can be demonstrated in the five year survival of patients with homologous and heterologous tumors. The most important factors in survival appear to be the histopathologic classification of the tumor, the presence or absence of metastases, and well planned radiotherapy.

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JOSEPH T. DANZER, M.D.

Irradiation for the Elimination of Nasopharyngeal Lymphoid Tissue. Donald F. Proctor. Arch Otolaryng 43:473-480, May 1946.

At the Hagerstown Clinic for the Prevention of Deafness in Children (described in a paper in the same issue of Arch Otolaryng pp 462-472), irradiation of nasopharyngeal lymphoid tissue was carried out in 323 patients (981 treatments). Many of the patients had not finished their treatments at the time of the report, but 100 had complete eradication of nasopharyngeal lymphoid tissue, and 144 patients had satisfactory regression of such tissue with clearing of the eustachian orifices. Ten patients showed no improvement, but only 2 of these had received more than two treatments.

Since irradiation produces its effects only over relatively long periods, it is difficult to evaluate results of therapy in a clinic which has been in existence only a little over two years. However, 19 patients with recur-

rent otitis media had remained well since treatment, 26 patients with chronic otitis media had had dry ears over a period of many months, 8 children with bronchial asthma ceased to have attacks, and 2 other children were greatly improved. Forty-three patients with unusually severe recurrent infection of the upper respiratory tract had remained relatively free from this condition for at least the preceding winter. Nine ears with severe impairment of hearing returned to normal,

and 268 ears showed definite improvement of hearing.

For the eight months preceding their report the authors had been using an applicator containing 50 mg of radium salt with a filter of 0.3 mm of Monel metal. The most effective dosage with this applicator was found to be 1 gm twenty seconds' on each side of the nasopharynx, since the applicator contains only 50 mg or 0.05 gm the time required for this dosage is twenty times as long—400 seconds.

EFFECTS OF RADIATION

Distribution of Radiation in the Atomic Bombing of Nagasaki John C Larkin. *Am J Roentgenol* 55: 525-532 May 1946

This study is based on the clinical records of 95 patients in three hospitals in Nagasaki, who were still hospitalized six weeks after the bombing of the city. Some of the energy released was in the form of radiation, the remainder and greater part of the energy being released as heat.

In order to facilitate this study the patients were grouped according to the zone of the city they happened to be in at the time of the explosion. There were few survivors in zone 1 (within 1,000 meters of the center of the explosion). Zone 2 (1,000 to 1,250 meters) was the zone where survivors showed maximum irradiation effects. Those in zone 3 (1,250 to 1,500 meters) showed slight irradiation effects. In areas beyond 1,250 meters severe superficial burns but practically no irradiation effects were found. Protection by walls or roofs of buildings played a part in reducing the irradiation effects. There were 9 people in concrete buildings in zone 2, 4 of whom had only mild evidence of roentgen sickness and no sign of burns. Twelve people in this zone with less protection, suffered severe roentgen sickness—profuse vomiting, hematemesis, melena and diarrhea. In zone 3 symptoms were much less severe and in the outer zone they were very slight. In no case was a typical erythema attributable to gamma radiation reported.

Superficial radiation effects (*i.e.*, ultraviolet visible light, and infra red) were by far the most widespread reactions, being found in all zones and as far as 2,500 meters from the radiation source. People in zones 3, 4, and 5 felt no heat but noticed burns several seconds after the explosion. Almost any article of clothing seemed to give them adequate protection. A single layer of clothing might give partial protection but several layers would not be penetrated. The burned areas were always facing the radiation source. These effects were not due to gamma radiation. In all cases healing was rapid and complete.

Seventy-six per cent of persons in zone 2 and 22 per cent of those in zone 3 lost part of their hair. Ten out of 11 women in zone 2 whose menses had been regular and 9 out of 12 in zone 3 had amenorrhea after the bombing. In some instances this may have been due to psychological factors.

Maximum depression of the white blood count was reached near the twenty-eighth day. The average count of 11 cases in zone 2 was 980. In zone 3 the average was 3,750. There was a normal count in a patient in zone 2 who was protected by a concrete roof. Patients who had combined irradiation effects and superficial burns died much earlier than those with pure irradiation effects. In the latter group the greatest number died at the end of the seventh week, demonstrating the delayed reaction to irradiation alone.

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Reasons for the Common Anatomic Location of Pulmonary Tuberculosis¹

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THE EARLY pathologists recognized that the principal lesions of pulmonary tuberculosis in European adults were cavitations and fibrocaseous nodules in the cephalad third of the lungs, and it was realized that the first cavities usually appeared near the apex, more often on the right. Precise knowledge of the development of all types of pulmonary disease was made possible by the roentgen ray, which confirmed and refined earlier views and established the frequency of healed primary complexes in the lungs and thoracic lymph nodes. The studies of Sweany (1) on location of single cavities may be taken as one of the best quantitative reports, fully confirming the right-sided and juxta-apical predilection of progressive lesions in adults.

The work of Medlar proved that in cattle and in rabbits the progressive lesions were usually far more numerous at the opposite anatomical site, namely the juxta-diaphragmatic and dorsal regions (2, 3). Medlar also observed, however, that in rabbits which had been kept erect by a harness for eleven hours each day the localization resembled that in man (3). It thus became evident that in animals with some resistance to tuberculosis the disease may become arrested in the parts

of the lungs which are on a level with the heart, in the gravitational field, while progressing in those parts which are farthest above the heart. In animals moving on four feet, progress occurs in the dorsal part of the lower lobe, but in those which are erect, even for half of the day, progressive lesions are extremely rare at the base and are frequent in the apical third of the lung.

Older theories, which attributed apical localization in man to the relative coldness of the apex, or to the peculiarities of the bronchi, are out of harmony with these animal observations, which prove that the explanation must lie in the effect of the gravitational field on the resistance in various parts of the lung. Roder's theory (4) that increase in hydrostatic pressure raised the vitality of cells, and thus made basal cells more resistant than apical ones, is nullified by two facts. In the air-filled lungs, pressure on all extravascular cells is uniform throughout the whole organ, and the disease flourishes in the extravascular tissues. If lowering pressure on the cells lowered resistance to tuberculosis, the disease would be more rapidly progressive as barometric pressure was reduced, but actually the beneficial effects of higher altitudes on human

¹ Presented at the Thirty second Annual Meeting of the Radiological Society of North America Chicago, Ill Dec 1-6 1946

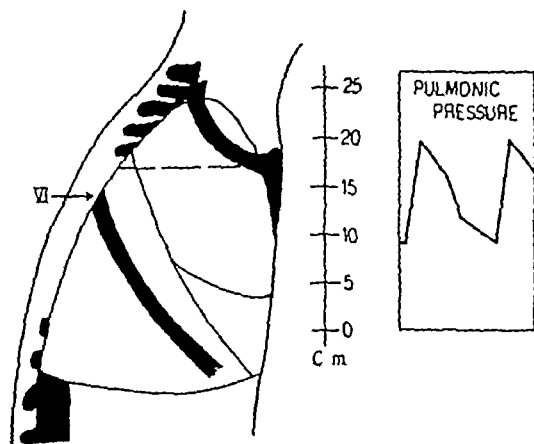


Fig 1 The pressure curve in the pulmonary artery during one heart cycle is shown, in centimeters of water and the lateral profile of the right lung, with height in centimeters above the center of mass of the right ventricle. The vertebrae and first and sixth ribs are indicated and the dotted line shows the level at which pulmonary flow must cease because hydrostatic pressure exceeds pulmonic arterial pressure. In mitral stenosis, the arterial pressure is two to six times as high as in this normal subject, apical ischemia does not occur, and apical tuberculosis is rare.

tuberculosis are generally conceded, and confirmed by animal experiment (5). Thus it was that Pinner and Rich, in their recent books on phthisis, stated that the cause of apical localization of adult type tuberculosis is unexplained.

The work of Cournand and Richards (6) has shown that, when recumbent, men have a systolic pulmonary arterial pressure of 18 to 30 mm Hg. As the cardiac output is less when the subject is sitting or standing than in recumbency, and pulmonary arterial pressure varies with the output, even lower pressures must occur in the right ventricles of persons who sit or move but little while on their feet. This means that the column of blood from the right heart to the apical part of the lungs exerts an equal or greater pressure (Fig 1). In view of the fall of pressure along the course of a vessel, there can scarcely be any blood flow, and no formation of lymph or tissue fluid, at the upper third of the lungs under these conditions. Because of the length and tortuosity of the right pulmonary artery, pressure on that side will be lower and the bloodless region larger than on the left.

In the horse (7), with a pulmonary arterial pressure of 35 to 58 mm Hg, and presumably also in cattle, the dorsal part of the lungs must be equally bloodless while the animal is at rest. There are no data on rabbits in the postures studied by Medlar and Sasano (2), but values for pulmonic pressure as low as 6 mm Hg have been recorded in the laboratory (7), and it seems probable that even in these small mammals the effect of gravity on the pulmonary blood column may greatly reduce the formation of lymph and flow of blood in the regions farthest above the heart.

As is well known, primary lung lesions initiated prior to development of resistance are disseminated generally throughout the lungs of men, cattle, and rabbits. It seems probable that in animals or men with reinfection or with rapid development of high resistance, an inadequate pulmonary blood flow, for many hours each day, may permit tuberculosis to progress in the lung field highest above the heart, while lower parts enjoy a considerable degree of immunity. In adults, progressive lesions observed soon after reversal of a negative skin test are usually in the upper lung field, and in the usual instances of "reinfection," apical disease progresses and the opposite apex becomes involved even though other regions, in spite of a constantly positive sputum, remain free for months, years, or decades.

Alveoli which are aerated through the bronchi, but deprived of the normal flow of pulmonary arterial blood, with its low oxygen saturation, will have the highest oxygen and lowest carbon dioxide content. This favors the growth of tubercle bacilli (5). It is obvious that in the bloodless zone toxins will accumulate, while in other regions they will be diluted and carried away by blood and lymph. Lymph also will remove bacilli to regional nodes, where their destruction leads to new formation of antibodies. In the ischemic zone, the antibody level will be low, for the quantity of antibody and the number of phagocytes brought by the blood will be negligible. Only during activity or recumbency,

both of which raise pulmonic pressure, will the blood flow in the apical regions equal that in other parts of the lungs and restore to the apex its full measure of resistance. In rabbits, eleven hours of erect posture out of twenty-four reversed the location of progressive lesions. In man, apical disease is particularly common in sedentary persons and in those who get few hours of sleep.

A comparison of the known pulmonic pressures with the anatomical and gravitational effects on flow to the regions commonly the site of progressive lesions suggests but does not prove that flow to these regions actually is diminished. Tests of a conclusive nature can be made by intravenous injection of small quantities of radioactive isotopes having soft gamma radiation. With suitable detecting devices, the number of impulses from various pulmonary fields can be registered immediately after an injection, when the material is passing through the lungs, and the effects of the recumbent and erect postures on the relative number of impulses at apex and base can be compared. Until such data are obtained, the reduced or arrested flow in the superior parts of the lung and the actual amount of lung so affected on each side are purely speculative.

One reason for accepting the probability that relative ischemia is the basis for the apical localization of phthisis in man is the very low incidence of progressive apical lesions in patients with mitral stenosis, and the very high incidence in those with pulmonic stenosis. In the former, pulmonic arterial pressure may be as high as 116 mm Hg and usually is over 40 mm (6), in the latter group pulmonic pressure and flow must be lower than in normals. In pulmonic stenosis, the apical regions probably are bloodless even at the peak of the patient's physical activity, and not merely when he is standing quiet. At all times the proportion of poorly perfused lung is far greater than in normal subjects. Though only a few such individuals reach adult life, apical tuberculosis has been active in a notable proportion (8). In

mitral stenosis, although it is particularly prevalent in the poor and leads to malnutrition, active apical tuberculosis is extremely rare (9), and comparison of the force of gravity with the level of pulmonic pressure makes it improbable that apical ischemia can occur in most of these patients. In the absence of data on blood flow in the normal apex in the recumbent and erect position, this statistical material is the most convincing support of the theory that the erect posture robs the apical zone of the blood and lymph flow, and hence of much of the protection enjoyed by other parts of the lungs in those who have developed resistance to tuberculosis.

The significance of this theory, in treatment by bed rest and collapse, has been presented elsewhere (10). At this time, it is merely necessary to stress that absolute recumbency, not rest in the propped up or sitting posture, is the factor most important in management. Perhaps even short periods of recumbency, at intervals of a few hours, can lower toxin concentration and turn the delicate balance against progress of the apical lesion. In any event, getting out of bed for short periods, to eat or to use toilet facilities, probably has no deleterious effect on the lesions, while improving the patient's morale and appetite. Granting that rest in the open air may help to keep patients quiet and recumbent, it can be argued that recovery does not depend on the rural atmosphere, or even on the lakes, woods, and mountains which, though dear to men like Trudeau, are hateful to many urban citizens, who long for home and friends. The wilderness sanatoria seem especially depressing to women, who echo Tibullus' query "*Dulcius urbe quid est? An villa sit apta puellae?*"

The arrest of pulmonary tuberculosis still depends on aiding the patient's own powers of resistance rather than on antibiotics. If his morale and resistance are raised by moving him into a new environment, sanatorium treatment will be helpful, but it seems clear that the really ef-

fective agent—rest flat in bed—requires no special apparatus or nursing, and is not dependent for its success on the absence of city sights and sounds. In 1882 Ewart closed his Gulstonian lectures (11) on pulmonary tuberculosis with a remark which is equally valid today. "The treatment of pulmonary cavities may look forward to a better future, if it seeks its foundation in a sound pathology."

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The Roentgen Findings in Early Coccidioidomycosis¹

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IT SEEMS VERY probable that the next few years will see a decided increase in the number of sporadic cases of coccidioidal infections reported from various sections of the United States where it is not now endemic. The unsettled socio-economic conditions of the post-war world with its accelerated rate of population migration, the anticipated increase in vacation travel to or through endemic areas, and the increasing use of the airplane and other rapid means of long distance transportation, all point to such a conclusion.

It has repeatedly been shown that coccidioidomycosis may be acquired by no more exposure than that incidental to passing through an area of endemic infection. These areas include large sections of the arid Southwest, having in common long, hot, dry and dusty summers. A definite correlation has been established between the number and severity of dust storms and the incidence of coccidioidal infections in these regions (4). Newly arrived residents have been observed to be particularly susceptible to the disease. The known zones of infection are especially the great central valley of California (the San Joaquin), the whole of Arizona (but particularly the regions about Phoenix and Tucson), Southwest Nevada, and parts of New Mexico and Western Texas. The disease is acquired by inhalation of dust contaminated with chlamydospores of the fungus, *Coccidioides immitis*. It is presumed that the fungus grows in the soil or on vegetation in the rainy season and that the spores dry up, break off, and are scattered by the wind in the dry season. An important intermediary host may be small rodents, which have been found to show a high incidence of nodular coccidioidal lung foci (13). The incubation period

averages about ten days to two weeks, sufficient time for travel, under modern conditions, from an endemic zone to any part of the country.

HISTORY

For the purpose of this paper, the following summary of the history of coccidioidomycosis is sufficient. Beginning with the discovery of the disease in its relatively rare disseminated form in Argentina in 1892 and in California in 1894, and the identification of the organism in 1904, there accumulated, over many years, detailed information concerning the behavior of the condition in its malignant variants.

In 1935 a primary, usually spontaneously recovering, pulmonary onset was proved, having far wider incidence than the serious disseminated form (14). There followed immunological proof of a still broader subclinical involvement as evidenced by the large proportion of residents of endemic areas who were shown to react positively to coccidioidin skin tests (26).

Throughout, the clarification of the roentgen manifestations of the disease naturally lagged behind that of clinical, pathological, and immunological considerations, inasmuch as the pioneering investigators were not radiologists. Before the war there were, in addition to the roentgenologic data given in articles not primarily roentgenologic, a number of papers dealing specifically with the roentgen manifestations (Powers, 25, Carter, 3, Winn and Johnson, 34). But these were generally based on cases either few in number or without adequate serial studies.

One of us (Carter), in 1941 (3), attempted such a study, stating that detailed roentgen characterization of the primary pulmonary disease must await serial roent-

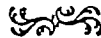
¹ From the University of Southern California. Presented at the Thirty second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-6, 1946.

fective agent—rest flat in bed—requires no special apparatus or nursing, and is not dependent for its success on the absence of city sights and sounds. In 1882 Ewart closed his Gulstonian lectures (11) on pulmonary tuberculosis with a remark which is equally valid today: "The treatment of pulmonary cavities may look forward to a better future, if it seeks its foundation in a sound pathology."

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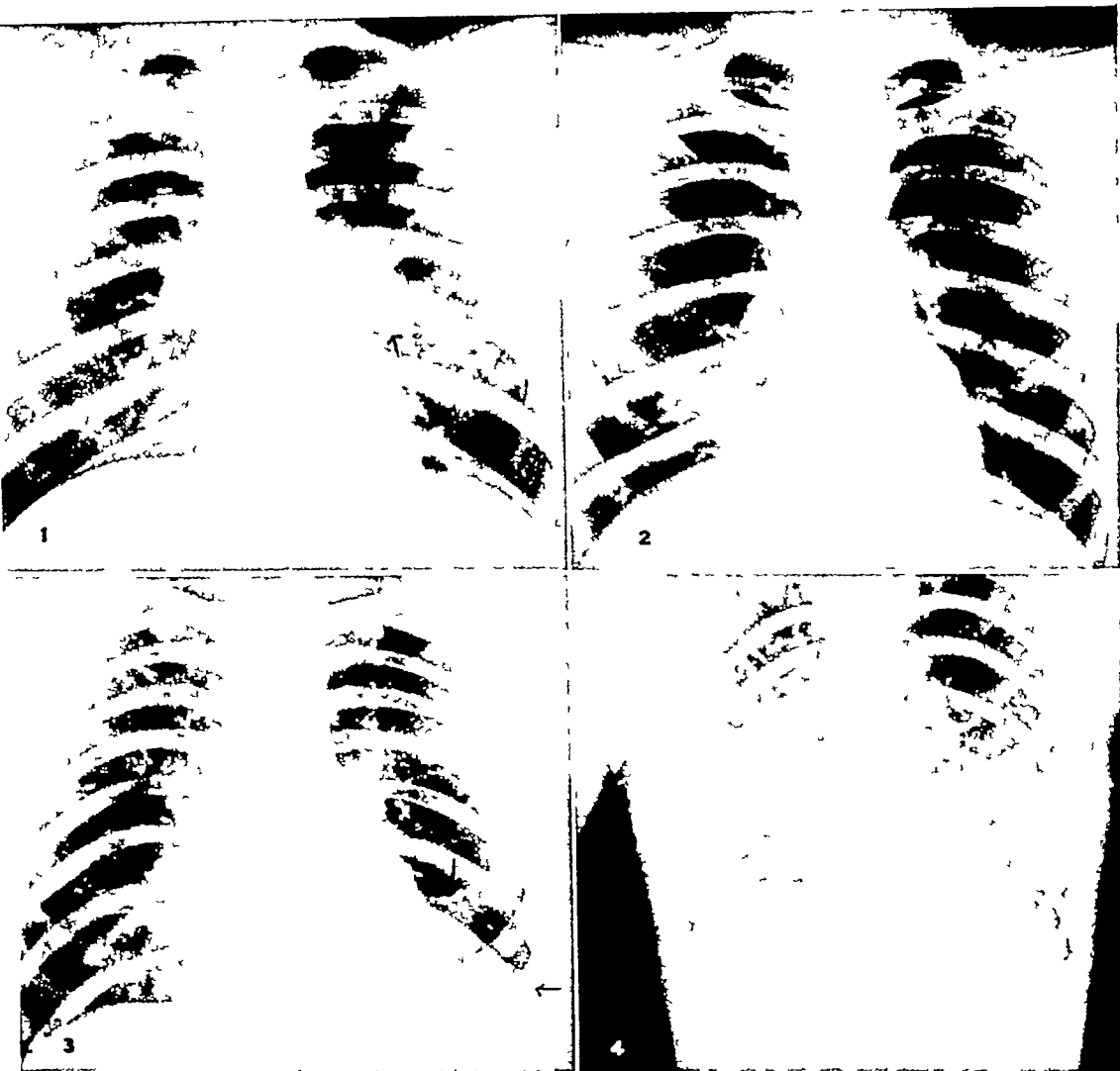


Fig 1 Acute primary coccidioidomycosis Left hilar thickening

Fig 2 Acute primary coccidioidomycosis Local zone of pneumonitis in the medio basal portion of the right lung

Fig 3 Acute primary coccidioidomycosis Small amount of infiltration at the left base, associated with slight pleural effusion

Fig 4 Acute primary coccidioidomycosis Extensive pneumonitis in the right lower lung Two weeks later the lung had cleared

is usually of a dry, irritating type, though small amounts of sputum may be raised. The temperature is of a spiking type, usually to $100-102^{\circ}\text{F}$. The white blood cell count is usually elevated, averaging 10,000 to 12,000, with mild increase in the neutrophil percentage. Eosinophilia of 3 to 15 per cent is frequently encountered and, when present, is a helpful diagnostic sign. One striking feature which is of especial importance in differentiating coccidioido-

mycosis from the commoner respiratory conditions is the occurrence of chest pain in a very high percentage of patients (87 per cent of acute cases) (18). This varies in degree from a sense of substernal tightness or constriction to a very sharp knife-like pain of pleural type.

Usually after three to ten days the temperature falls to normal, and the patient feels that he has recovered from his illness, even though films taken at this time

gen observations in many cases continued well past the period of clinical illness. These requirements have been met due to the circumstance that a number of endemic areas were especially favorable for military training. The hazard was known. Precautions were taken with the able advice and assistance of C E Smith. Capable clinicians and radiologists were available, these were alerted and adequate hospital and follow-up observations were made, accompanied by thorough immunological, laboratory, and roentgenologic studies. Detailed residence and travel records were obtained in each case. As a result, hundreds of cases have been thoroughly studied roentgenologically, with all associated information needed, in a manner not practicable in civilian life. A number of radiologists have each seen a large series of cases, up to a hundred or more (5, 10, 15, 18, 22, 23, 27, 29, 32). This overcomes the irregularity of sampling in fewer cases, gives adequate display of less frequent manifestations, and permits correlation of varied points of view of individual authors.

Some differences of opinion are evident, particularly in the earlier papers. These may be explained in part by different concepts of pathogenesis or simply by differences in the descriptive terms used, but perhaps more important are the varying concepts derived from differences of sampling in cases seen. One of us (3), for example, had encountered an exceptional number of the disseminated infections but relatively few of the early cases, and these were, on the average, relatively severe. His experience, moreover, was dominated somewhat by the fact that in a charity hospital adjacent to, but not in, a major endemic area, the initial infection and illness were apt to arise elsewhere and not be seen by him unless the attack were prolonged or of over-average severity. Also, among his patients there was a predominance of the colored and dark-skinned races, who are prone to coccidioidal infections of unusual severity. Correspondingly, mediastinal adenopathy was stressed in his presentation (1941) of primary coccid-

iomycosis to an extent not supported by other authors. Colburn (5), reporting on an "epidemic," speaks only of hilar thickening and enlarged hilar nodes, and not at all of mediastinal adenopathy. His cases, numbering 75, would appear to be of average sampling, weighted neither by an excess of cases milder or more severe than average.

DIAGNOSIS

The clinician working in endemic areas and accustomed to seeing many cases of "valley fever" has little difficulty in recognizing the disease. The diagnosis is relatively simple once the condition is thought of, but recognition of the sporadic case which appears in a non-endemic area requires special alertness on the part of the physician to the possibility of such an infection. The diagnosis of coccidioidomycosis should be considered in the case of any person who, having recently returned from a zone of endemic infection, presents evidence of a respiratory disease. An intradermal coccidioidin-skin test with a 1/100 concentration of potent extract, if negative, will generally rule out the disease in all but a few of the more severe disseminated infections (10, 31). If the test is positive, under these circumstances, a presumptive diagnosis of coccidioidomycosis is warranted. The diagnosis is established with certainty by positive precipitin or complement-fixation tests, which are found only in the presence of active infection. These tests are unfortunately open to the objection that some of the milder cases may give a negative reaction. Final proof is obtained by culture of sputum or guinea-pig inoculation, with demonstration of the causative organism.

Clinically, the conditions which are most likely to be confused with acute primary coccidioidomycosis are influenza and primary atypical pneumonia (19). The patient complains of backache, headache, or general aching, or marked weakness, slightly sore throat, loss of appetite, and various indefinite gastro-intestinal disturbances. Cough is nearly always present and



Fig 6 Primary coccidioidomycosis A. Nodular well circumscribed lesion in the lower left lung B. In the nodular lesion shown in A central cavitation is developing after a period of six months

infiltration in about nine out of ten cases. Infiltrations vary in extent from the slightest fuzzy thickening of hilar shadows to extensive consolidations occupying a major portion of a lung field. The infiltrations are mostly unilateral, homogeneous, usually hilar or basal in location, and show little tendency to lobar distribution. They vary in density from the lightest veil-like haze to consolidations approaching, but rarely equaling, the opacity of lobar pneumonia. As a rule, they are more uniform, less patchy, more circumscribed than the usual bacterial bronchopneumonias.

To the radiologist, the appearance is most likely to suggest the findings encountered in primary atypical pneumonia. And, as a matter of fact, it is not often possible, on the basis of roentgenograms alone, to differentiate the two conditions (19). To add to the confusion, the clinical signs and symptoms of the two diseases are often quite similar. Differentiation may be possible only by resort to coccidioidin or specific laboratory tests. Indeed, it would seem advisable in endemic zones to do routine skin tests on all persons suspected of primary atypical pneumonia.

The similarity between acute coccidioidomycosis and primary atypical pneumonia may be carried further to include rheumatic pneumonitis. That the whole pic-

ture of acute coccidioidomycosis may closely resemble rheumatic fever is shown by the fact that "desert rheumatism" is one name for the mycosis, and the fact (Griffith, personal communication) that in military service, where alertness to the disease is high, a number of cases were transferred to centers where rheumatic fever was treated, there to be proved coccidioidomycosis. While the primary event in rheumatic pneumonitis is the occurrence of an anaphylactic angitis with multiple local infarctions, the presenting evidence upon the roentgenogram would be a highly cellular and exudative reaction in the alveoli and adjacent structures (16). As a matter of fact, all these diseases—primary atypical pneumonia, coccidioidomycosis, and rheumatic pneumonitis—are ones in which a highly cellular response to infection occurs, and it is only natural that they should reveal considerable similarity, roentgenographically. Moreover, the migratory tendency which is so pronounced a feature of rheumatic pneumonitis is also encountered to a lesser degree in primary atypical pneumonia and occasionally in coccidioidomycosis.

PERSISTENT COCCIDIOIDAL INFECTIONS

With persistence of coccidioidal infection, the patient may complain of low-grade

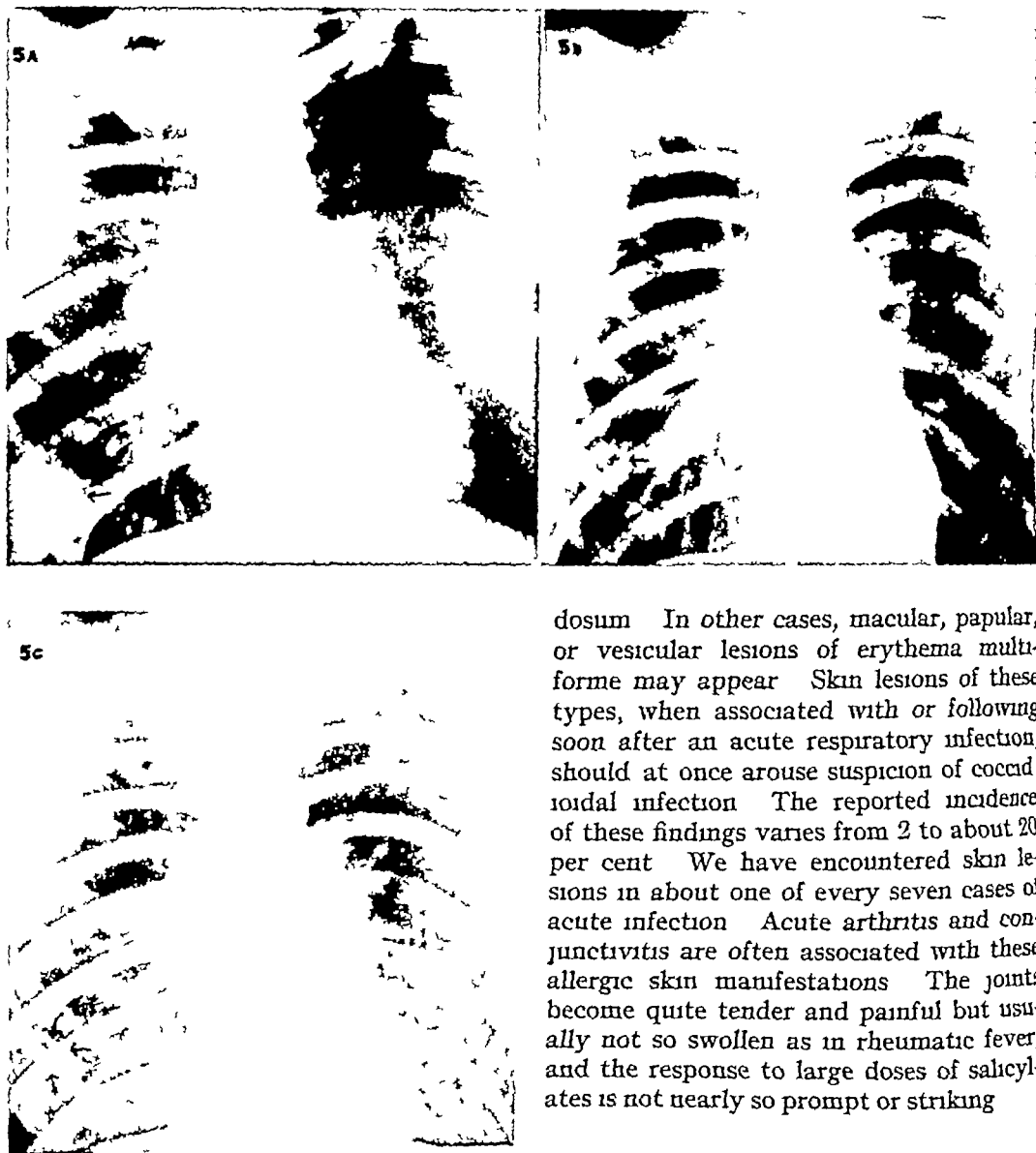


Fig 5 A Acute primary coccidioidomycosis. An unusually severe case with hilar and mediastinal adenopathy. Local zone of infiltration at right base. B Primary coccidioidomycosis. The mediastinal and hilar adenopathy shown in A has regressed after a period of six weeks, the local zone of pneumonitis at the right base has been replaced by an isolated ring-like cavity. C. The mediastinal and hilar lymph adenopathy shown in B has further regressed after a period of ten weeks, the cavity previously present has disappeared leaving a residual nodule.

may show considerable residual infiltration. Then, one or two weeks later, painful nodules may develop on the shins and elsewhere, characteristic of erythema no-

dosum. In other cases, macular, papular, or vesicular lesions of erythema multiforme may appear. Skin lesions of these types, when associated with or following soon after an acute respiratory infection, should at once arouse suspicion of coccidioid infection. The reported incidence of these findings varies from 2 to about 20 per cent. We have encountered skin lesions in about one of every seven cases of acute infection. Acute arthritis and conjunctivitis are often associated with these allergic skin manifestations. The joints become quite tender and painful but usually not so swollen as in rheumatic fever, and the response to large doses of salicylates is not nearly so prompt or striking.

ROENTGEN FINDINGS IN ACUTE PRIMARY COCCIDIOIDOMYCOSIS

In the earlier stages of initial infection the roentgen findings are quite non-specific and could as well be explained by ordinary bronchopneumonia, primary atypical pneumonia, rheumatic pneumonitis, or, if the upper lung fields are selectively involved, by tuberculosis. Only special alertness to the possibility of the disease would cause it to be considered.

A film of the chest taken at the time of onset will show some degree of pulmonary

many of the more severe and protracted coccidioidal infections. Approximately one-third of the cases of persistent pneumonitis will show some degree of associated adenopathy, while practically all fatal cases will present this finding at least some time during their course. Mediastinal adenopathy, on the other hand, is uncommon in association with the usual acute transitory infections and is almost never seen with focalized infections of the nodular or cystic types, later to be described.

The occasional patient in whom mediastinal adenopathy is the dominant or sole roentgen finding may be initially believed to have Hodgkin's disease, primary tuberculosis, sarcoidosis, etc. Mediastinal adenopathy accompanied by hilar infiltration has been mistaken for bronchiogenic carcinoma. The fact that patients with mediastinal coccidioidal adenopathy are usually chronically ill, with weight loss, weakness, anorexia, and anemia, adds to the confusion with malignant neoplastic disease. The association of fever, chest pain, and perhaps eosinophilia may help in the differentiation. But even here, the clinical findings may be misleading, since chest pain is not infrequently a prominent characteristic of bronchiogenic carcinoma, and fever and eosinophilia may accompany Hodgkin's disease.

Pleural effusion is encountered in approximately one-fifth of all acute primary cases but ordinarily is so small in amount as scarcely to fill the costophrenic angle, it resolves rapidly and completely as a rule. In a small percentage of cases, pleurisy with effusion may be massive and persistent, so that in the presence of spontaneous effusions of unknown origin, the possibility of coccidioidomycosis should be considered when the patient has recently returned from a zone of endemic infection.

RESIDUAL COCCIDIOIDAL FOCI

In view of the fact that the acute primary phase of coccidioidomycosis is often mild, transitory, and not unlike the common respiratory infections, the disease is often passed off as a simple "cold" or "flu" and



Fig 8 Primary coccidioidomycosis. Lumpy mediastinal adenopathy. Infiltration radiating from hilar regions. Chest films were entirely normal after a period of two and one half months.

readily forgotten. It thus not infrequently happens that the roentgenologist encounters residual "burned-out" foci of coccidioidomycosis without any apparent history of antecedent infection. This is particularly true of radiologists engaged in mass survey or routine hospital photo-roentgen studies. The roentgenologist may be surprised to see a sharply circumscribed nodule 1 to 4 cm in diameter, which he may suspect of being an uncalcified primary tuberculous focus or a solitary metastasis. In the case of multiple nodules, he is likely to make a diagnosis of extensive metastatic carcinoma, for what is actually a benign condition. At other times, isolated thin-walled ring-like cavities 1 to 8 cm in diameter are encountered which, when they occur in the middle or lower lung fields, may readily be mistaken for congenital cysts. When apical or subapical in origin, they are often misdiagnosed as being of tuberculous origin.

The acute illness in those patients followed directly through from a preliminary stage of pneumonitis to nodule formation is usually no more severe or prolonged than in cases in which infiltrations clear completely. (An exception is the occasional case in which numerous widely scattered



Fig 7 Primary coccidioidomycosis Ring like cavity in the left midlung

fever, weakness, abnormal fatigability, chronic cough, intermittent chest pain, and mild to moderate weight loss. Hemoptysis may occur whether or not a cavity is present. If the patient is seen at this time, a clinical diagnosis of pulmonary tuberculosis may be made. Moreover, the chest films may confirm this erroneous impression, especially if persistent pneumonitis occurs in the upper lung fields. Failure to find acid-fast bacilli in the sputum has usually been the decisive factor in stimulating search for other possible infections. Inasmuch as the great majority (85 to 90 per cent) of acute coccidioidal infections clear relatively rapidly within a matter of two to six weeks, and are usually hilar or basal in location, the ultimate differentiation from tuberculosis is only occasionally a difficult problem. Nevertheless, tuberculosis enters frequently enough into the differential diagnosis that, in cases seen in endemic areas, it would appear time-saving to make tuberculin and coccidioidin tests routinely, at the same time. Moreover, certain cases of coccidioidal pneumonitis are found to persist for many months or years before finally clearing. We have seen 21 patients with benign, non-disseminated infections of this type lasting from three months to over two years (18). Confusion

with tuberculosis is especially likely in this group.

One form of protracted primary coccidioidomycosis deserves special consideration. In this, there is profuse involvement usually in an upper lobe, in which multiple cavities are evident in a zone of confluent infiltration, identical in appearance with advanced ulcerative tuberculosis, but with persistent failure to find the acid-fast bacillus. Coccidioidomycosis may be identified through recognition of the organism, by coccidioidin, or complement-fixation test. One of us (Carter) has seen several of these cases through the alertness of the Olive View Sanatorium. Complete regression may occur in a manner which is slow for coccidioidomycosis but which would be sensational for tuberculosis.

It is not yet fully evident how far the early phase of pulmonary infection by histoplasmosis may come into comparison with coccidioidomycosis. That both diseases have residual calcifications is now well established. The active phase of histoplasmosis has not yet been studied in a sufficient number of cases. Palmer (24) has shown comparable pulmonary involvement. One of his cases, at least, revealed a hilar and mediastinal adenopathy more advanced than is seen in any but the most severe of coccidioidal infections. As in coccidioidomycosis, the parenchymal lesions may be of indolent type, prone to slow resolution. The widely different endemic areas and the early age at which histoplasmosis occurs should make the need for differentiation relatively infrequent.

Torulosis, like coccidioidomycosis, is considered to have a pulmonary onset. While it is prone to be generalized, with a special predilection for the central nervous system (Hamilton and Tyler, 17), a fifth of the patients, or so, have pulmonary lesions. While these have not been typed roentgenologically with any degree of completeness, confluent lesions have been illustrated which tend to regress over periods of months even though the central nervous system involvement supervenes.

Mediastinal adenopathy accompanies

On the other hand, *Coccidioides immitis* is, as a rule, not difficult to recover when a cavity is present and the patient is raising even a small amount of sputum

Roentgenologically, most coccidioidal cavities are so characteristic that they are seldom confused with other conditions when occurring in endemic areas. A solitary thin-walled ring-like shadow without surrounding infiltration is typical (33). Cavities are occasionally encountered with walls so thin and sharply defined as closely to simulate congenital cysts. Sante and Hufford (28) have described annular lung shadows in certain pyogenic infections which look remarkably like those of coccidioidomycosis. We have seen three cases in which cavities contained fluid and were surrounded by infiltration in such a fashion as to suggest lung abscess. The differentiation from tuberculosis in the case of apical cavities, and especially those which are occasionally surrounded by coccidioidal pneumonitis, is often not radiographically possible. Certain other mycotic infections may produce lesions closely resembling those of coccidioidomycosis, roentgenographically. For instance, a case of geotrichosis has been illustrated (6) which displayed multiple ring-like cavities identical with those seen in coccidioidomycosis. A case of torula infection of the lung is also illustrated which closely resembles the nodular type of coccidioidal lesion (6).

DISSEMINATED COCCIDIOIDAL INFECTIONS

A discussion of disseminated coccidioidal infections is not in the scope of this paper. Suffice it to say that the patient not infrequently first presents himself for medical care with evidences of disseminated foci already present. Often a history of an acute antecedent infection cannot be obtained or is overshadowed by the severity of the disseminated disease. In white patients the presenting symptoms are frequently those of meningitis, while in the Negro the presenting evidence will more often be that of multiple cold abscesses arising subcutaneously or from caseous lymph nodes or bone foci. In these cases

the roentgen findings in the chest will be primarily those of mediastinal adenopathy associated with varying degrees of infiltration up to massively confluent miliary disease with multiple areas of bone destruction resembling metastatic carcinoma. Benign chronic indolent forms of the disease are also encountered which persist for many years in the form of small warty outgrowths on the skin, chronic draining sinuses, or chronic coccidioidal osteomyelitis, without seriously impairing the patient's health or jeopardizing his life. The diagnosis is easily made by biopsy or culture from the local lesion.

SUMMARY

1 The diagnosis of coccidioidomycosis is not a difficult one if the physician is alert to the possibility of such a condition. The disease should be suspected in the case of any person recently returned from an endemic zone of infection, who presents the signs and symptoms of a respiratory infection. If a positive coccidioidin test is obtained under these circumstances, a presumptive diagnosis of coccidioidomycosis is warranted. A negative test rules out the disease in all but the most severe infections. The diagnosis is established with certainty by a positive complement-fixation or precipitin test or by recovery of the causative organism from the sputum by culture or guinea-pig inoculation.

2 In the acute pneumonic phase of the disease, the roentgen appearance is non-specific, and differentiation from primary atypical pneumonia, rheumatic pneumonitis, and other respiratory infections cannot ordinarily be made from the roentgenograms alone.

3 Residual "burned-out" nodular or cyst-like foci of coccidioidomycosis are quite characteristic in roentgen appearance and are seldom confused with other conditions when occurring in endemic areas. Among diseases to be differentiated are primary tuberculosis, metastatic carcinoma, congenital cyst, adult tuberculosis, lung abscess, pyogenic and mycotic infections. The discrepancy between the clinical



Fig 9 Primary coccidioidomycosis. Tuberculosis like apical infiltration with infraclavicular cavities

patches of pneumonitis give rise to multiple nodular foci. The onset in these cases is typically quite severe.) The initial illness in cases destined to develop cavities is generally more acute, with symptoms of malaise, cough, chest pain, and fever to 100 to 103° lasting two to four weeks. Infiltrations preceding nodulation or cavitation are fairly homogeneous zones of consolidation 2 to 10 cm in diameter, which tend to round out with decrease in size, leaving the isolated nodule or cavity at the center of the zone of previous pneumonitis. The elapsed time from the initial pneumonitis to nodule formation averages about three to six weeks but occasionally is as long as two or three months. Cavities not infrequently develop through central excavation of nodular foci over a period of several weeks or months and, when arising in this fashion, are usually smaller and thicker-walled than the cyst-like cavities which arise directly from the initial consolidation and have a more doughnut-like appearance.

All nodules and cavities have proved remarkably indolent, slow in evolution and benign in character. But minor fluctuations in cavity size and wall thickness have been recorded in practically all cases. At times, fluctuations in cavity size were of

such degree and occurred so rapidly as strongly to suggest ballooning due to air trapping. Some of the larger thinner-walled cavities have been observed to collapse rapidly over a period of several days, either to reappear just as suddenly or to disappear permanently. Others have gradually diminished in size to end as small nodules. But many months are generally required for cavities to disappear completely. Of one group of 35 cavities followed for an average of seven and one-half months, less than half had disappeared in that time, and some have been followed for as long as two years without appreciable reduction in size. As for the coccidioidal nodules, these appear to persist for many years with little change. We have been able to follow only a single one of these foci through to complete resolution. From other studies (Cox and Smith, 7, Aronson, 1, Butt and Hoffman, 2), it is evident that some, at least, go on to eventual calcification.

The differentiation of these coccidioidal lesions from conditions which they simulate is based to a large extent on the marked discrepancy between the clinical and roentgen findings. The nodular and cystic foci of coccidioidomycosis are essentially benign residual foci which persist for many months or years following the initial acute disease without materially impairing the patient's health or well-being. A large percentage of these residual foci are discovered on routine roentgen examinations without prior clinical indication of disease. In one survey, 15 of 23 nodular foci and 13 of 35 cavity cases were so discovered. The patient's temperature, white blood cell count, complement-fixation titre, and sedimentation rate are usually in the normal range, and the disease apparently never spreads to other lung tissue or disseminates. Patients with residual cavities not infrequently complain of intermittent sticking chest pain and occasionally cough and hemoptysis. The absence of tubercle bacilli in the sputum on repeated examinations helps to direct attention away from tuberculosis as the source of infection.

Pulmonary Sarcoidosis The Early Roentgen Findings¹

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THE PULMONARY changes in sarcoidosis are now recognized as constituting one of the most conspicuous manifestations of this bizarre and no longer rare disease. They are usually described as being of one of the following types: (a) lymph node enlargement, (b) miliary or nodular lung densities, or (c) a combination of nodal enlargement and pulmonary infiltration. Are there any particular lesions suggestive or characteristic of *early* pulmonary sarcoid disease? In an attempt to determine this point, we studied a series of cases of sarcoidosis which we have been privileged to see during the last several years (33 of which were proved by biopsy or necropsy) and reviewed much of the now voluminous literature on the subject. Since sarcoidosis is a disease of protean manifestations and constant changeability, we believe it will be well to consider briefly its salient features before analyzing the purely pulmonary aspects.

CLINICAL ASPECTS OF SARCOIDOSIS

Sarcoidosis is a generalized disease of unknown origin, in which characteristic histologic changes are found in different organs and tissues (17, 19). It is usually of insidious onset and tends to run a chronic, relapsing course. Fairly mild constitutional symptoms are manifested in most cases, and quite severe, even fatal, signs in a few. It is discovered most commonly between the ages of twenty and thirty years, but cases have been reported in patients as young as two months (19) and as old as eighty years (11). It may develop in persons of any race, but *seems* to occur with somewhat greater frequency in Negroes than in others (12, 13, 14).

Although a widespread, disseminated disease, it is often observed in a phase

when involvement of only one system is apparent, for example, lesions of the skin, the eyes, or the lungs. The clinical picture varies from case to case, and from time to time in the same case. The victims may have no complaint or may complain of fever, fatigue, or slight dyspnea. Peripheral lymphadenopathy is present at some stage of the disease in about 90 per cent of cases, the nodes being painless, discrete, and movable. Pulmonary involvement (parenchymal or nodal) occurs in a similar percentage of cases. Cutaneous and ocular lesions are seen in about 40 per cent of cases. The usual skin lesions are described as sharply defined, brownish nodules (cutaneous or subcutaneous) distributed over the face or extremities (12). The common ocular finding is a chronic bilateral granulomatous iritis, or iridocyclitis, without much redness or pain. This may regress spontaneously or progress to complete blindness. Hepatomegaly and splenomegaly are fairly frequent. Cardiac and pericardial involvement has been noted. As in Hodgkin's disease, *any* tissue or structure can be invaded.

Infiltration of the salivary apparatus may lead to "Mikulicz's disease," and of the parotid glands and eyes to "uveo-parotid fever." Granulomatous invasion of the bone marrow is fairly common, but roentgenographic evidence of such is noted only in a small percentage of cases (7), appearing either as multiple radiolucent areas or diffuse lace-like rarefactions. These are most common in the phalanges of the hands and feet, but may occur in any bones, notably the long bones of the extremities. Hyperglobulinemia, with reversal of the albumin-globulin ratio, is a common finding, eosinophilia is not infrequent. The serum calcium and phosphorus

¹ Presented at the Thirty second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec 1-6 1946

cal and roentgen findings is often helpful in establishing the diagnosis

4 Cases in which mediastinal adenopathy is dominant are usually among the more severe and prolonged of infections and give rise to most of the fatalities. Among the conditions to be considered in the differential diagnosis are Hodgkin's disease, pulmonary tuberculosis, sarcoidosis, and bronchiogenic carcinoma

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tase values may be slightly increased (8, 19, 20)

The tuberculin reaction is usually negative. A certain number of cases, however, are eventually complicated by tuberculosis or other serious infection, especially in their terminal stages (15, 17). The diagnosis is made *in vivo* by the demonstration of a non-caseating or "hard" tubercle in a biopsy specimen, usually from a node or skin nodule. The conditions with which sarcoidosis is most often confused are tuberculosis and Hodgkin's disease.

HISTORICAL NOTE

The skin changes of sarcoidosis were described in 1889 by Besnier (3), who designated them lupus pernio, and in the same year by Boeck (4), who called them sarcoid. The latter term was used because the author considered that they might be related to the sarcomata or pseudoleukemic disorders, in 1901 he changed the name to benign miliary lupoid, and in 1905 stressed the fact that the lesions were also found in mucosal tissues, lymph nodes, and internal viscera. In 1916, Schaumann (16) emphasized the histologic identity of the lesions of lupus pernio and miliary lupoid and stressed the fact that they were of widespread occurrence throughout the body. Other writers (6, 11, 19) have described conditions or syndromes involving certain areas or tissues (such as Mikulicz's disease, Heerfordt's syndrome), all of which are now known to be merely manifestations of sarcoidosis. Synonyms include benign lymphogranulomatosis, reticulosis, and reticuloendotheliosis.

The bone changes of sarcoidosis were first described by Jüngling in 1919 as "osteitis tuberculosa multiplex cystica" of the phalanges, nine years later he changed the term to "osteitis tuberculosa multiplex cystoides". Finally, it was recognized that the changes were due to sarcoid infiltration of the bone marrow and, like other sarcoid lesions, were reversible (though fibrotic changes persisted in the marrow of arrested cases) (20).

HISTOLOGIC CHANGES

The essential lesion of Boeck's sarcoidosis is a miliary tubercle composed of a central giant cell surrounded by epithelioid cells and lymphocytes, the giant cell sometimes containing an asteroid body. No perituberculous inflammatory reaction, caseous necrosis, or calcification occurs, thereby distinguishing the sarcoid tubercle from the true tuberculous tubercle. In addition, of course, tubercle bacilli are frequently found in the tuberculous tubercle, and never in the uncomplicated sarcoid tubercle. The sarcoid tubercle has a tendency to undergo hyalinization and fibrosis.

Carnes (5) has emphasized that the following diseases require differentiation from sarcoid on the basis of lymph-node examination alone: (a) non-caseating pulmonary tuberculosis, (b) leprosy (tubercloid form), (c) syphilis, (d) fungous infections, as coccidioidomycosis, (e) tularemia, (f) lymphopathia venereum. He points out that consideration of the clinical findings, plus the result of suitable antigen tests (tuberculin and lepromin skin reactions, serological examination, coccidioidin and Frei tests, etc.) will help the clinician to distinguish these entities.

Gross and microscopic lesions similar to those in sarcoid have been found (22) in some zinc-beryllium-silicate workers (fluorescent lamp manufacturers, etc.).

Williams and Nickerson (22), Snapper (17), and others (11) have suggested that the disease may be due to a virus; they are convinced that it is *not* due to any form of the tubercle bacillus. On the other hand, Pinner (13) considers that it is a bizarre form of tuberculosis. Thomas (20) lists seven authors who claim to have found tubercle bacilli in "sarcoid lesions" (and five who reported "sarcoids" in leprosy!). Snapper observes that "this cannot be considered proof of a tuberculous etiology, since in diabetes mellitus, Hodgkin's disease, and leprosy a terminal tuberculosis is not infrequent."

PULMONARY FINDINGS REPORTED IN THE LITERATURE

(a) *Pathologic* The microscopic changes in the lungs of persons with sarcoidosis consist of diffuse, non-caseating tubercles in the periadventitial layers of the smaller arteries in the interalveolar septa, with variable degrees of fibrous degeneration (17). The latter may progress to obliteration of the interalveolar pulmonary capillaries. The lymph nodes and lymphatic structures of the mediastinal, hilar, and pulmonary tissues show more or less invasion by these tubercles, with swelling or fibrosis, depending on the stage of involvement. As Pinner (13) remarks, "there is not only uniformity, but monotony in regard to the histologic findings in this disease." The predilection of sarcoids for the lymphatic structures of the interlobular septa explains the diffuse streaking so often seen in pulmonary roentgenograms, according to Bernstein and Sussmann (2). Sarcoid fibrous tissue may ultimately replace the pulmonary lymphoid structures.

Readers interested in viewing excellent reproductions of the gross and microscopic changes produced by sarcoid lesions in the lungs, heart, and other viscera, are referred to Cotter's (6) and Tice and Sweany's (21) illuminating articles on this subject.

(b) *Roentgenologic* The descriptions of the various roentgenologic changes in the lungs of persons with sarcoidosis are as varied as the protean manifestations of the disease. This is due partly to the fact that individual cases are seen at certain phases of the disease with widely variable degrees of lung or lymph node involvement, and partly to inadequacies in our roentgenologic descriptive terminology.

Snapper (17) described (a) disseminated pulmonary nodulation, (b) diffuse interstitial fibrosis, and (c) lobar collapse from hilum adenopathy. This adenopathy was often of severe degree ("potato nodes"). Both lung and node lesions might disappear or might persist for many years. Four of 13 cases were followed for five to twenty years, and extensive lesions which regressed

did not recur. Snapper did not indicate his impression as to which constituted the early roentgen findings.

Longcope and Pierson (11) noted similar changes in 8 cases, and re-emphasized the changeability of the pulmonary findings from year to year.

Spencer and Warren (18) maintained that certain "characteristic" changes in the lungs occurred in this disease.

Tice and Sweany (21) reported a fatal case of pulmonary sarcoidosis, in which, incidentally, the successive clinical diagnoses during life were pulmonary tuberculosis, Hodgkin's disease, Ayerza's disease, and mediastinal tumor. In their opinion, "the early lung lesions appear on the roentgenogram usually as nodules simulating disseminated tubercles, or small soft infiltrates with an associated hilum lymph node enlargement. As the lesions become chronic, there is a disappearance of their 'soft' nature and the appearance of a stringy and net-like fibrosis over the entire lung fields, especially out from the hilum. A late emphysema usually appears."

Kerley (9), in a discussion on erythema nodosum and sarcoidosis, described the changes as of two general types: (a) pulmonary nodular infiltrate, with lesions averaging 3.0 mm in diameter, and (b) a coarse reticular striation radiating from the hila. He observed that both types are usually present together and that, in about 50 per cent of cases, hilar adenopathy also occurs, "the adenopathy appearing and regressing often in a very short time, for example in three to five days." He regards the "erythema-nodosum-sarcoidosis" of Europe as being closely related to, if not identical with, the "erythema-nodosum-coccidioidomycosis" of California.¹

Thomas (20) reported 15 cases of sarcoidosis, with pulmonary involvement in most of them, there were 3 deaths, one due to pulmonary tuberculosis developing within a year after the sarcoids first appeared, one to massive pulmonary infarction as a result of hilar node pressure, and one to amyloidosis some four years after the sarcoidosis appeared. Of the remain-

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HISTORICAL NOTE

The skin changes of sarcoidosis were described in 1889 by Besnier (3), who designated them lupus pernio, and in the same year by Boeck (4), who called them sarcoid. The latter term was used because the author considered that they might be related to the sarcomata or pseudoleukemic disorders, in 1901 he changed the name to benign miliary lupoid, and in 1905 stressed the fact that the lesions were also found in mucosal tissues, lymph nodes, and internal viscera. In 1916, Schaumann (16) emphasized the histologic identity of the lesions of lupus pernio and miliary lupoid and stressed the fact that they were of widespread occurrence throughout the body. Other writers (6, 11, 19) have described conditions or syndromes involving certain areas or tissues (such as Mikulicz's disease, Heerfordt's syndrome), all of which are now known to be merely manifestations of sarcoidosis. Synonyms include benign lymphogranulomatosis, reticulosis, and reticuloendotheliosis.

The bone changes of sarcoidosis were first described by Jüngling in 1919 as "ostertis tuberculosa multiplex cystica" of the phalanges, nine years later he changed the term to "ostertis tuberculosa multiplex cystoides." Finally, it was recognized that the changes were due to sarcoid infiltration of the bone marrow and, like other sarcoid lesions, were reversible (though fibrotic changes persisted in the marrow of arrested cases) (20).

HISTOLOGIC CHANGES

The essential lesion of Boeck's sarcoidosis is a miliary tubercle composed of a central giant cell surrounded by epithelioid cells and lymphocytes, the giant cell sometimes containing an asteroid body. No perituberculous inflammatory reaction, caseous necrosis, or calcification occurs, thereby distinguishing the sarcoid tubercle from the true tuberculous tubercle. In addition, of course, tubercle bacilli are frequently found in the tuberculous tubercle, and never in the uncomplicated sarcoid tubercle. The sarcoid tubercle has a tendency to undergo hyalinization and fibrosis.

Carnes (5) has emphasized that the following diseases require differentiation from sarcoid on the basis of lymph-node examination alone: (a) non-caseating pulmonary tuberculosis, (b) leprosy (tubercloid form), (c) syphilis, (d) fungous infections, as coccidioidomycosis, (e) tularemia, (f) lymphopathia venereum. He points out that consideration of the clinical findings, plus the result of suitable antigen tests (tuberculin and lepromin skin reactions, serological examination, coccidioidin and Frei tests, etc.) will help the clinician to distinguish these entities.

Gross and microscopic lesions similar to those in sarcoid have been found (22) in some zinc-beryllium-silicate workers (fluorescent lamp manufacturers, etc.).

Williams and Nickerson (22), Snapper (17), and others (11) have suggested that the disease may be due to a virus, they are convinced that it is *not* due to any form of the tubercle bacillus. On the other hand, Pinner (13) considers that it is a bizarre form of tuberculosis. Thomas (20) lists seven authors who claim to have found tubercle bacilli in "sarcoid lesions" (and five who reported "sarcoids" in leprosy). Snapper observes that "this cannot be considered proof of a tuberculous etiology, since in diabetes mellitus, Hodgkin's disease, and leprosy a terminal tuberculosis is not infrequent."

coidosis, with variable degrees of pulmonary involvement. None of these considered the disorder from the specific point of view of early chest findings, and reference to them is therefore omitted in this paper.

AUTHOR'S SERIES

We are reporting in this paper the chest roentgenographic findings in 36 cases of sarcoidosis, 33 of which were verified by histologic examination, and 3 of which were so well established clinically that the validity of the diagnosis appears unquestionable. Several of these, as in Reisner's series, were discovered incidentally in routine chest x-ray examinations of apparently healthy persons. Two of them were found during fluoroscopic examination of the gastro-intestinal tract because of mild abdominal complaints. Most of the cases were subjected to extensive clinical and laboratory examination in order to rule out other diseases, notably tuberculosis, coccidioidomycosis, histoplasmosis, Hodgkin's disease, and syphilis. A few were observed sufficiently soon after negative roentgen examinations elsewhere to warrant assumption that the pulmonary findings were truly early.

The following were the salient findings in our group as a whole.

Age, Sex, and Nationality The ages ranged from 11 to 74 years, slightly over half of the patients being in the twenties. There were 14 males and 22 females. Twenty-one patients were white and 15 colored, the latter group consisting of 1 Puerto Rican and 14 American-born negroes. All of the whites on whom natal data were available were born in this country.

It is probable that the average age, sex, and nationality depend largely upon the material analyzed. At our City Hospital, many of the patients are middle-aged or elderly white females, the sarcoid cases from this institution were of similar composition. At the Oakland Naval Hospital, many of the patients were young males, the sarcoid cases encountered there were

of a similar type. However, as other observers have noted, negroes do show a proportionately greater tendency to involvement than whites.

Initial Roentgen Findings The thoracic roentgen findings may be divided into those showing apparent involvement of the lungs alone, those indicative of lung and lymph node involvement, and those apparently indicating lymphadenopathy alone. The pattern of the lung involvement is extremely variable, ranging from true miliary densities, through coarse nodulation and apparent linear fibrosis, to coalescent curvilinear or pneumonic shadows, all with or without adenopathy. There is absolutely nothing characteristic in the findings in the individual case, however, the apparent excellent health of the person in contrast with the extensive roentgen shadows often warrants a surmise as to the nature of the latter. The miliary and nodular lesions are due to aggregations of sarcoids in the lung parenchyma. The linear lesions may be due to sarcoid lymphangitis, to lymphedema, to congestion or, occasionally, to fibrotic changes.

Pulmonary lesions alone, without visible hilar or mediastinal adenopathy, were present at the initial examination in 10 cases. One showed disseminated miliary lesions, that is, parenchymal densities of about 1 mm diameter. Four showed diffuse or localized nodulation—parenchymal densities varying from 1 to 5 mm in diameter, mostly about 3 mm. Four showed linear shadows, usually irregular and "fibrotic" looking. One showed coalescent bronchopneumonic-like lesions.

Pulmonary lesions and lymphadenopathy were present at the initial examination in 13 cases. Six showed diffuse or localized nodular lesions with adenopathy, while 7 showed diffuse or localized linear densities with adenopathy.

Lymphadenopathy, hilar, mediastinal, or both, was present as the sole thoracic roentgen finding at the initial examination in 11 cases. Six showed bilateral hilar plus right paratracheal adenopathy, 3 showed hilar adenopathy alone, and 1 each

ing 12 cases, 7 persisted unchanged, and 5 spontaneously recovered from all detectable lesions

King (10) discussed a group of 50 cases from the point of view of chest roentgenography, some 24 of them proved by biopsy of skin or lymph nodes. He classified the lesions as falling into various patterns, such as hilar node enlargement, miliary pulmonary changes, etc. He stated that in none of his cases did fibrotic changes develop (or right heart failure secondary to such changes). Many cleared completely, the average time for clearing being twenty-two months. King did not comment on the possible pattern of the earlier lesions.

Reisner (14), in a comprehensive review of 35 biopsy-proved cases followed for an average period of 4.3 years, observed pulmonary involvement at some time in 33 of them. In many instances the chest findings were discovered on routine x-ray examination or in mass surveys of apparently well persons. In half of the cases—17—lymphadenopathy and pulmonary involvement were the only demonstrable findings. There was no correlation between the extent of involvement and the subjective symptoms. The roentgen findings were described as usually bilateral and diffuse, but occasionally unilateral and localized. They predominated in the lower two-thirds of the lungs. None was pathognomonic.

Reisner found (a) diffuse miliary or nodular lesions in about one-third of the cases, (b) linear accentuation of the bronchovascular markings, usually with nodulation, in another third, and (c) localized or pneumonic infiltrates in the remainder. He regarded the miliary-like, disseminated, nodular form as an early stage of the disease. "Of 10 patients in whom the pulmonary changes became manifest during the course of observation, 8 presented lesions of the diffusely disseminated type." The linear, interstitial, fibrotic form and the conglomerate type were regarded as intermediate or late stages and, in contrast to the former, usually irreversible. Incidentally, 4 of the cases

developed as complications of pulmonary tuberculosis, with positive sputum, two additional patients died of generalized tuberculosis, without manifest pulmonary infection *in vivo*.

The mediastinal and hilar nodes were involved in most of Reisner's cases, usually bilaterally. Spontaneous regression, during a period of several months or years, occurred in half of these. Of the entire group, 27 were followed long enough to permit some estimate as to their behavior, 5 remained *stationary*—usually the linear fibrotic or confluent density type—some showing alternating remissions and exacerbations, 9 showed *progression*, usually to conglomerate densities, often with fibrosis, bronchiectasis, and emphysema, 13 showed *regression*—usually the disseminated miliary or nodular type—some with complete clearing.

Bernstein and Sussmann (2) reported 12 cases proved by histologic examination. They divided the roentgen findings into five groups: (a) enlarged hilar nodes without evident pulmonary infiltration, (b) mediastinal adenopathy with variable degrees of pulmonary infiltration, (c) miliary pulmonary lesions (with or without mediastinal adenopathy), (d) discrete nodular infiltrates (with or without hilar adenopathy), (e) diffuse confluent infiltrations.

Bernstein (1), in a subsequent paper on the miliary form of the disease, divided the intrinsic pulmonary lesions into three groups: (a) a diffuse linear, strand-like pattern, often with hilar adenopathy, (b) diffuse, patchy, or confluent densities, (c) miliary forms, either diffuse or limited to the lower two-thirds of each lung. Transitions from one type of infiltration to another were often noted under prolonged observation. Bernstein is in agreement with Reisner that cases with the shortest duration of symptoms tend to show a miliary distribution, many of them regress spontaneously. The linear or conglomerate forms tend to persist, with development of fibrosis.

Several other writers have described from one to as many as nine cases of sar-

that he observed the development of such lesions in 8 out of 10 cases in which the pulmonary changes became manifest during the course of observation

We reviewed our material in an attempt to establish certain cases as early. While some 30 patients had no pulmonary symptoms (6 being discovered on routine chest survey of apparently healthy persons), only 2 had well established negative clinical histories and negative roentgen examinations for a period of weeks or months prior to our initial examination. In one of these 2 cases (Case 16) hilar and right paratracheal adenopathy developed while the patient was under observation, and in the other (Case 28) bilateral nodular parenchymal lesions developed, more marked in the right lung. In neither of our well established early cases, therefore, was there a miliary pulmonary pattern.

However, in the 6 cases encountered in "healthy" persons, and in 6 additional cases in which pulmonary symptoms were absent and clinical signs of disease elsewhere in the body were of only a few days' or weeks' duration (Cases 5, 19, 20, 21, 22, 23, 26, 27, 30, 32, 35, and 36), the following findings were observed

	Cases
Disseminated miliary pulmonary lesions	1
Diffuse or localized nodular lesions	2
Nodular densities with adenopathy	3
Linear densities with adenopathy	3
Adenopathy alone	3

All of these cases may reasonably be regarded as early ones, even though previous negative chest films are not always available to establish them as positively so. It will be noted that only 1 showed miliary disease, while 8 showed nodular or linear densities.

If we tabulate the 2 definite with the 12 probable early cases, we observe the following roentgen findings as the first established ones

Disseminated miliary lesions	1
Nodular lesions (diffuse or localized)	3
Nodular or linear parenchymal densities with adenopathy	6
Adenopathy alone	4

On the other hand, if we follow cases over a long period of time, we encounter some (such as Case 9) in which a miliary or "granular-type" of parenchymal lesion develops as an apparent extension of a pre-existing localized lymph nodal or pulmonary nodular process. It is, therefore, our impression that there is more chance of the primary pulmonary manifestation of sarcoidosis being one of combined parenchymal densities plus lymphadenopathy than of being purely a miliary parenchymal process.

TABLE III EARLY PULMONARY ROENTGEN FINDINGS IN SARCOIDOSIS (Author's Series)

	Cases
Disseminated miliary parenchymal lesions	1
Diffuse or localized nodular parenchymal lesions	3
Parenchymal lesions with adenopathy (usually bilateral hilar and right paratracheal)	6
Adenopathy alone (hilar and right paratracheal)	4

DIFFERENTIAL ROENTGEN DIAGNOSIS

The differential diagnosis of pulmonary sarcoidosis requires consideration of so many lesions of similar gross anatomic pattern that it is manifestly impossible on the basis of a single roentgen examination alone. The following are some of the conditions which may simulate the disease: (a) miliary pulmonary disease of any type, such as tuberculosis, coccidioidomycosis, carcinosis, etc., (b) nodular pulmonary disease of any type, such as pneumoconiosis, severe chronic passive congestion, Ayerza's disease, leukemia, virus or coccidial pneumonitis, viral pneumonia, eosinophilia, bronchopneumonia, periarteritis nodosa, byssinosis, schistosomiasis, and fungous infections, (c) parenchymal infiltrative or fibrotic disease, such as chronic fibroid tuberculosis, lymphoblastoma, roentgen pneumonitis, paragonimiasis, etc., (d) mediastinal and hilar disease, as tuberculous adenopathy, lymphoblastoma (Hodgkin's type especially), aneurysmal dilatation of the pulmonary arteries, etc.

These various conditions can often be excluded on clinical and other grounds. Skin tests for many of the entities are help-

TABLE I INITIAL OR FIRST NOTED PULMONARY ROENTGEN FINDINGS

(Author's Series All Cases, Both Early and Late)

Roentgen Findings	Case Numbers*	Total
Pulmonary lesions alone		
Disseminated miliary type densities	32	1
Diffuse nodular densities	28 36	2
Localized nodular infiltration	2, 28	2
Diffuse or localized linear densities (fibrotic type)	3, 17, 18, 33	4
Patchy coalescent densities	1	1
Pulmonary and nodal lesions		
Diffuse or localized nodular densities with nodes	5, 12, 23, 27, 29, 34	6
Diffuse or localized linear densities with nodes	8 10 13 19, 20, 30 31	7
Nodal lesions alone		
Bilateral hilar and right paratracheal adenopathy	9 14 21, 22, 24, 35	6
Hilar adenopathy, alone	4 11, 25	3
Paratracheal adenopathy	8	1
Other (e.g. hilar and left paratracheal adenopathy)	15	1
NOTE The lungs were clear in Case 7 at initial examination and at necropsy. They were also clear in Case 16 at first, later hilar and paratracheal adenopathy developed		1
		<u>36</u>

* Cases designated by italic numbers showed a "sarcoid type" of lymph node change, i.e., bilateral hilar and right paratracheal adenopathy

paratracheal adenopathy alone, and hilar plus left paratracheal adenopathy

There were two patients without thoracic roentgen findings at the initial examination, one died shortly thereafter of generalized sarcoidosis, in the other hilar adenopathy developed after three weeks' observation

Pleural thickening was noted in only one case at the initial examination, and developed subsequently in one other. Pleural effusion was present in only one case

The intrathoracic lymph node enlargement tended to conform to a curious pattern in 13 of the 24 cases showing adenopathy. We have not seen this observation recorded previously in the literature and we are stressing it at this time because we believe it may be of suggestive diagnostic

value in some cases. The pattern was one in which there was simultaneous enlargement of *both sets of hilar nodes* and only the *right upper mediastinal or paratracheal nodes*. This occurred in 7 of the cases with combined parenchymal and nodal lesions, and in 6 of the cases with nodal lesions alone. We have been led to regard this as suggestive of "sarcoid-type" adenopathy (see Fig. 8 for typical example)

As far as *symptoms* referable to the thoracic area were concerned, only 6 patients complained of these at the initial examination, and in only about three others did any such symptoms develop during the entire period of observation

The *course* of the cases showed wide variation. In 10 there was evidence of regression or complete clearing of the lesions during a period of six months to three years, in 4 the lesions remained stationary for periods up to seven years, in 3 there was progression of the lesions during periods up to six years. Nineteen cases were followed for less than six months and, therefore, are regarded as under observation too short a time to permit statements as to progress

TABLE II BEHAVIOR OF PULMONARY LESIONS UNDER SERIAL OBSERVATION

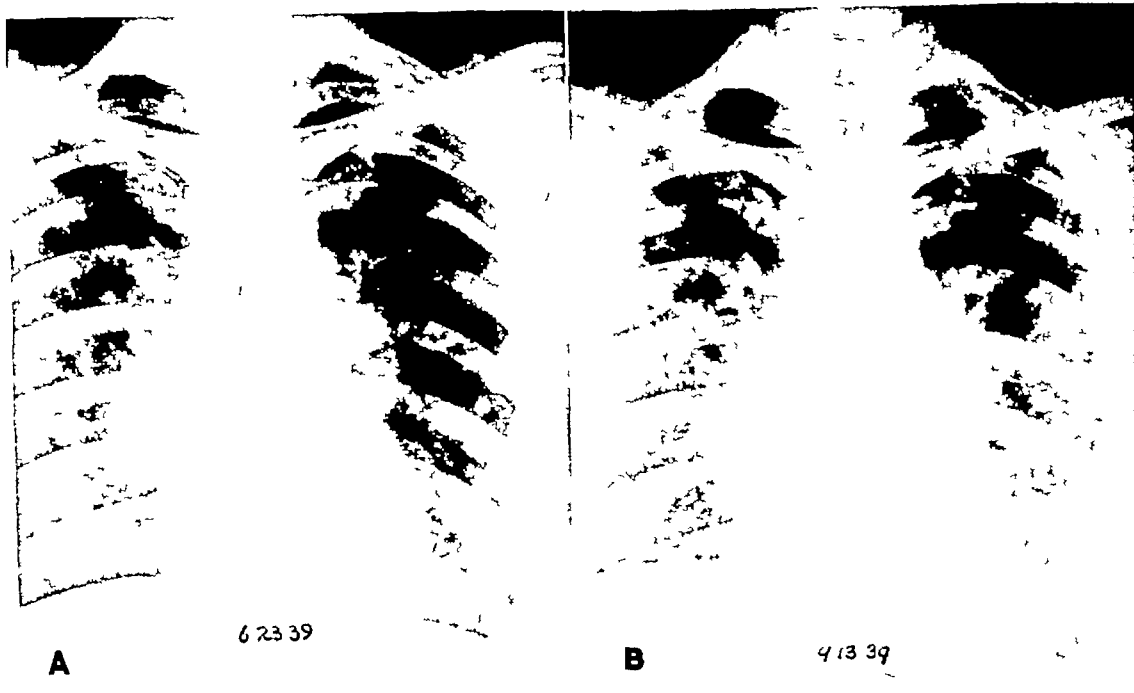
(Author's Series)

1	No. of cases showing <i>regression</i> of lesions during period of 8 months up to 3 years	10
2	No. of cases in which lesions were <i>stationary</i> observation period 6 months to 7 years	4
3	No. showing <i>progression</i> of lesions during period of 6 months to 6 years	3
4	Observation period too short (less than 6 months)	19

NOTE Some cases showed alternate regression and progression of both parenchymal and nodal lesions, occasionally after years of stationary behavior. Therefore, the observations in this table even those of 7 years duration cannot be regarded as final

EARLY ROENTGEN FINDINGS

The nature of the "primary" or, if such exists, "first re-infection type" sarcoid lesion in the lungs is not yet established. The author has previously referred to several writers who have expressed the opinion that the early pulmonary lesion is a diffuse miliary one. Reisner (14) states



thirds, grossly resembling a tuberculous bronchopneumonia. Microscopically, non caseating miliary tubercles, without calcification or bacilli. Heart enlarged, old aortic stenosis, with fresh vegetations on one valve. No definite tubercles in myocardium.

Summary A white male with clinical diagnosis of lymphosarcoma, and necropsy diagnosis of pulmonary sarcoidosis, diffuse, confluent stage.

CASE 2 E F, white, female, 50. Dyspnea for two years, swollen fingers for eleven months. History of old 'lupus vulgaris' of face, and skin "tubercloid" on left forearm. Roentgen findings: slight nodular infiltration in lower lobe of right lung, extensive cystic and porotic changes in phalanges of hands. Clinical diagnosis: arteriosclerosis and bronchial asthma. Biopsy of skin nodule showed cluster of epithelioid cells and some giant cells, no caseation or bacilli. Course: unimproved.

Summary A white female with pulmonary symptoms out of proportion to the slight roentgen changes, and classical sarcoid soft-tissue and bone changes in the hands. She may have had myocardial sarcoidosis as the principal lesion.

CASE 3 V T, white, female, 44. Weakness, and painless mass in left upper abdominal area for eight weeks. Malaria at age 5, typhoid at 16, influenza at 24. Tuberculin and coccidioidin tests negative. Roentgen findings: bilateral fibrotic-like densities in the lower two thirds of the lungs, hands negative. Clinical diagnosis: splenomegaly. Laparotomy and biopsy of spleen and abdominal nodes, non-caseating tubercles. Course: slow

Fig 1 Case 5 Pulmonary sarcoidosis 'Classical' course with spontaneous improvement. White female, 47, with erythema nodosum and no pulmonary symptoms. Positive skin biopsy.

A. Bilateral hilar adenopathy with slight pulmonary nodular infiltration.

B. Bilateral pulmonary "fibrotic" and nodular changes, right basal pleural thickening.

C. Marked improvement (June 1939 to July 1940).

ful Histologic study of a removed node is often decisive. Despite the absence of pathognomonic findings in general, we are convinced that there are certain patterns quite suggestive of pulmonary sarcoidosis, if information on the clinical status of the patient is at hand. In order of frequency, these are

(a) Bilateral hilar and right paratracheal adenopathy, with or without associated pulmonary infiltration or nodular densities

(b) Widely disseminated pulmonary milary or nodular densities without calcification, in a person clinically well

(c) Massive enlarged hilar nodes (potato nodes) in an apparently well person

The presence of associated lesions in the peripheral nodes, skin, and uveal tract is obviously of diagnostic value to the alert clinician. Bone lesions are often stressed, but those of a classical cystic type are reported in only about 10 per cent of the cases occurring in this country. We believe, however, that porotic changes are visible in some of the phalanges or long bones of the hands and feet in at least an additional 10 per cent. These "*coarse trabeculae with cortical thinning*" may be due to a host of other conditions but, in association with pertinent thoracic findings, are of diagnostic value to the radiologist. In sarcoidosis, they are due to infiltration of the marrow with hard tubercles and fibrous tissue.

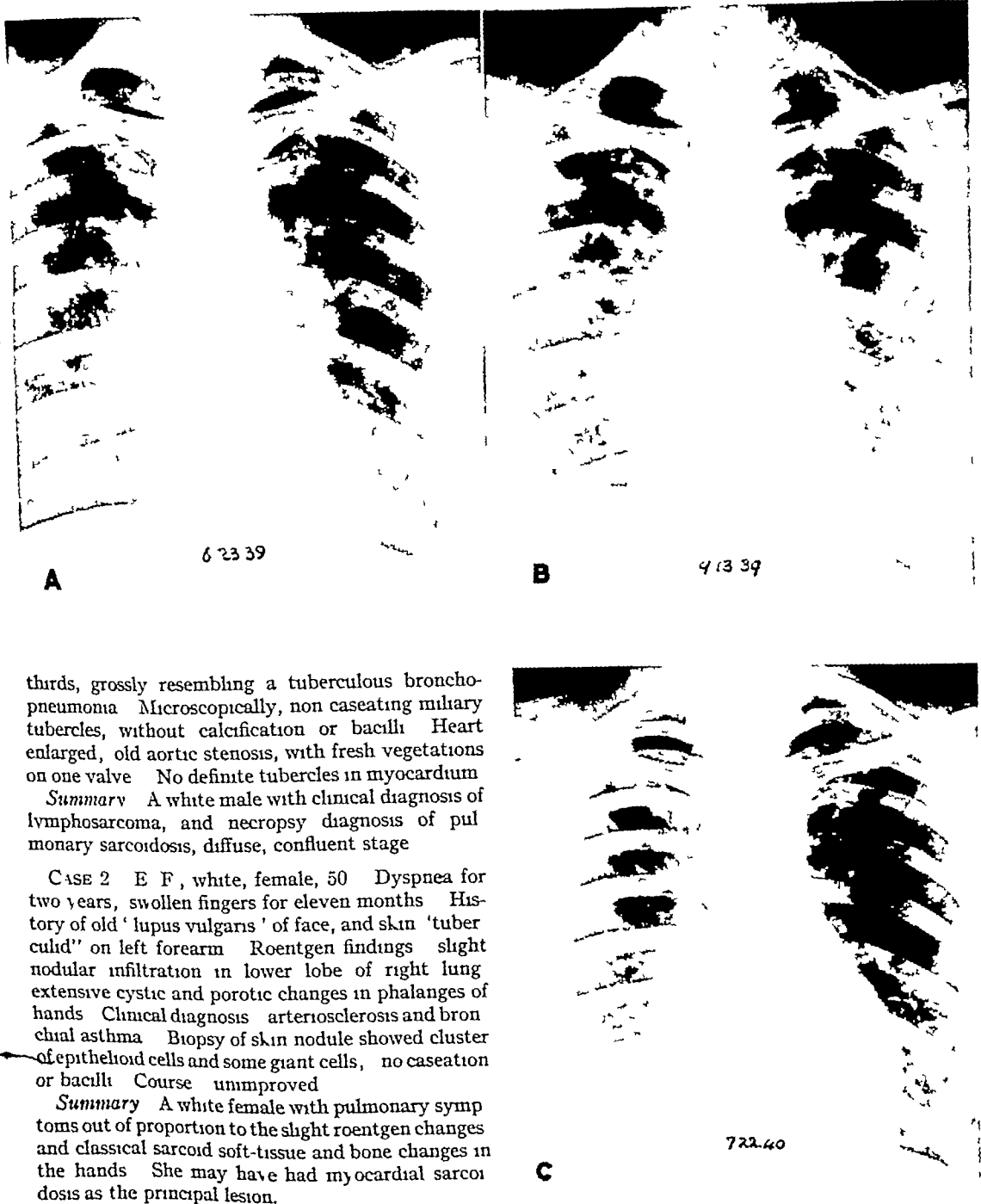
CASE REPORTS

Introductory Note For purpose of brevity, only positive findings will be listed in the following case reports. Thus, in a given case, skin lesions, enlarged nodes, ocular disease, etc., may be regarded as absent or not detected if not specifically mentioned. The blood Wassermann test was negative except as noted. *Tuberculin tests* were performed in most cases, usually down to dilutions of 1:10, coccidioidin tests to 1:100, histoplasmin tests in the standard dilution currently available. All of these tests were negative except as indicated in two instances. Examination of sputum and/or gastric washings for tu-

bercle bacilli was performed in all cases (often ten or more times over a period of weeks or years), and was *negative* except in one questionable instance. Guinea-pig inoculations were made in many cases without resulting tuberculosis. Agglutination tests for typhoid, paratyphoid, brucellosis, tularemia, and other disorders were made in a few cases and were uniformly negative. The blood counts were usually normal, except for occasional eosinophilia, neither they nor the urine examinations will be recorded in these summaries except when abnormal. Albumin-globulin ratios² were determined in 15 instances, blood calcium and serum phosphatase levels in only a few cases. X-ray examination of the hands or feet was negative except as otherwise noted. Most of the histologic studies were made by Drs. D. A. Wood or A. J. Cox of Stanford University Medical School, some were done by Dr. J. L. Carr, and by other experienced pathologists. To all of these able workers we wish to record our deep appreciation. Their biopsy reports usually listed such findings as "Many small tubercles, made up of epithelioid cells and a scattering of lymphocytes, most contain one or more giant cells. There is no central necrosis. Some fibrosis is present about the tubercles. Asteroid bodies are (or are not) present. No acid-fast organisms are found. Conclusion: Non-caseating granuloma." These reports we have condensed to "sarcoid" (*Boeck's*), in view of the associated clinical and laboratory data which we list. Specific skin tests for sarcoidosis have not been of value in our series.

CASE 1 C. F., white, male, 27. Cough and progressive weakness for three months. Roentgen findings: enlarged heart, bilateral confluent densities in lower two-thirds of lungs (? bronchopneumonia or fungous infection). Clinical diagnosis: lymphosarcoma or bronchopneumonia. Sudden death. Necropsy findings: milary tubercles scattered throughout lungs; confluent in lower two

² Hyperglobulinemia and a reversed albumin globulin ratio are often found in sarcoidosis. The normal serum proteins range from 8 to 8 mg per cent; the normal albumin from 3.8 to 5.5 mg, and globulin from 1.5 to 3.5 mg. The standard A/G ratio is usually given as 1.7 to 1.



thirds, grossly resembling a tuberculous bronchopneumonia. Microscopically, non caseating miliary tubercles, without calcification or bacilli. Heart enlarged, old aortic stenosis, with fresh vegetations on one valve. No definite tubercles in myocardium.

Summary A white male with clinical diagnosis of lymphosarcoma, and necropsy diagnosis of pulmonary sarcoidosis, diffuse, confluent stage.

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Summary A white female with pulmonary symptoms out of proportion to the slight roentgen changes and classical sarcoid soft-tissue and bone changes in the hands. She may have had myocardial sarcoidosis as the principal lesion.

CASE 3 V T, white, female, 44. Weakness, and painless mass in left upper abdominal area for eight weeks. Malaria at age 5, typhoid at 16, influenza at 24. Tuberculin and coccidioidin tests negative. Roentgen findings: bilateral fibrotic like densities in the lower two thirds of the lungs, hands negative. Clinical diagnosis: splenomegaly. Laparotomy and biopsy of spleen and abdominal nodes, non-caseating tubercles. Course: slow

Fig 1 Case 5. Pulmonary sarcoidosis. "Classical" course with spontaneous improvement. White, female, 47, with erythema nodosum and no pulmonary symptoms. Positive skin biopsy.

A. Bilateral hilar adenopathy with slight pulmonary nodular infiltration.

B. Bilateral pulmonary "fibrotic" and nodular changes, right basal pleural thickening.

C. Marked improvement (June 1939 to July 1940).



Fig 2 Case 9 Sarcoidosis Granular, pseudo-miliary pulmonary infiltrate developing relatively late in the disease White female, 17, who, six years and a half previously had bilateral hilar and right paratracheal adenopathy Positive skin biopsy See case report in text for details of serial roentgen examinations etc B Detail view of granular infiltrate (pseudo-miliary)

improvement Three years later chest about 33 per cent better

Summary A white female with splenomegaly, abdominal lymphadenopathy, and chronic pulmonary disease, due to sarcoidosis (Three year follow-up)

CASE 4 M E, white, female, 18 Severe head ache for six weeks, one episode of severe abdominal cramps two months ago, recent "swelling of right eyeball" Tuberculin, coccidioidin, and Frei tests negative Roentgen findings slight questionable left hilar adenopathy, skull negative Clinical diagnosis possible multiple sclerosis Course rapid blindness of right eye, orbital decompression without benefit, tissue about optic nerve removed and reported inflammatory tissue One year later, iridocyclitis in left eye Four years later, appearance of an abdominal mass laparotomy disclosing enlarged prepancreatic nodes (histologically non-caseating tubercles) Then sudden blindness of left eye Two years later, slight improvement in this eye Patient can now distinguish light and darkness Chest film stationary lung parenchyma always clear

Summary A young white female with meningeal, ocular, and abdominal sarcoidosis and blindness (Eight year follow up)

CASE 5 A B, white, female, 47 Painful swellings about the ankles, subcutaneous nodules on the chest and arms Roentgen findings bilateral hilar adenopathy with slight pulmonary nodular infiltration Clinical diagnosis erythema nodosum Biopsy of subcutaneous nodule from left elbow, showing sarcoid A-G ratio 3.76:3.31 One year later, marked spontaneous improvement

Summary A white female with erythema nodo-

sum, skin nodules, and chronic lung changes due to sarcoid

CASE 6 C C, white, male, 40 Bilateral facial palsy for ten weeks, swollen parotid glands, history of radiation therapy to mediastinum for Hodgkin's disease five months previously Roentgen findings bilateral paratracheal adenopathy, lung parenchyma negative Biopsy of left epitrochlear node showing sarcoid A-G ratio 4.08:2.35 Five months later, chest almost clear One year later, bilateral upper lobe infiltrate Palsy improved Hands negative initially, but four years later showed phalangeal cyst like areas Patchy phalangeal osteoporosis developed in feet, also Left facial palsy recurred after four years, with dizziness, parotitis, etc

Summary A white male with chronic, intermittent, meningeal, nerve, lung, and bone changes due to sarcoid (Four-year follow up)

CASE 7 A H, white female 67 Weakness for seven months, cough and nasal discharge for three months Bilateral parotitis Roentgen findings chest negative Biopsy of parotid gland granuloma Progressive downhill course Necropsy granulomatous lesions, with non caseating miliary tubercles in the kidneys, liver nasal cartilages, and pituitary gland

Summary An elderly white female with generalized sarcoidosis, which spared the lungs and bones, as far as could be determined during the brief period of observation and at necropsy

CASE 8 C D, white, female 45 Chronic 'eye trouble' Brownish, indurated nodules on the skin of the arms and legs for three months Roentgen findings slight bilateral hilar adenopathy and pul-

monary "fibrotic" infiltration Hands coarse trabeculae in phalanges Clinical diagnosis iridocyclitis, chronic, bilateral Biopsy of skin nodule sarcoid Course not known

Summary A white female with sarcoidosis of the skin, eyes lungs, and bones

CASE 9 B H, white, female, 13 "Rough areas on skin" of face and forearms for four years Roentgen findings marked bilateral hilar and slight right paratracheal adenopathy, lungs virtually clear Over a period of two years, nodes receded partly, and nodular pulmonary infiltrate developed Hands and feet showed bone changes Biopsy of skin nodule sarcoid A G ratio 3.98:3.4 Course gradual improvement Six years later, some skin lesions still present, Disseminated miliary type of pulmonary lesions present, hilar nodes gone The following is a condensed summary of the serial roentgen findings in the chest

7-29-40 Marked hilar and slight right paratracheal adenopathy, lungs virtually clear, diagnosed tuberculous adenitis

2-8-41 Nodes smaller, slight bilateral perihilar infiltration

11-1-41 Nodes larger, nodular infiltration in middle third of each lung

10-1-42 Nodes larger (bilateral hilar and right paratracheal, marked), infiltration now in right upper lobe

1-8-44 Nodes smaller, nodular infiltration much more extensive, especially on the right.

6-6-45 Nodes smaller (only right paratracheal nodes evident), pulmonary nodulation slightly coarser

11-2-46 Diffuse, fine granular infiltration in middle three quarters of each lung

Between 1943 and 1945, both cyst-like and porotic (lacy) changes were visible in a few of the phalanges of the hands and feet The intracutaneous sarcoids also persisted

Summary A young girl with cutaneous, pulmonary, and osseous sarcoidosis, chronic.

CASE 10 G G, colored, female, 42 Weakness and marked loss of weight, eight months Slight adenopathy Roentgen findings bilateral hilar adenopathy, perihilar infiltration or lymphangitis Biopsy of node sarcoid A G ratio 4.42:5.68 Course unknown

Summary A female negro with pulmonary sarcoidosis and marked weight loss

CASE 11 A B, white, female, 50 Bilateral facial palsy, deafness, eye trouble, and swollen glands Skin lesions on arms Roentgen findings bilateral hilar adenopathy, marked Clinical diagnosis ? sarcoid, with iridocyclitis, etc. Biopsy of skin nodule sarcoid Course unknown

Summary A white female with sarcoidosis of the meninges or cranial nerves, eyes, parotids skin, and lungs



Fig 3 Case 11 Sarcoidosis Enlarged hilar nodes White, female, 50, with facial palsy, deafness, iridocyclitis, and parotitis Positive skin biopsy

CASE 12 G J, colored, male, 25 Failing vision in the left eye Clinical examination disclosed iridocyclitis, cervical adenopathy, parotid swelling, and intracutaneous nodules on the forearms Roentgen findings slight hilar and marked right mediastinal adenopathy, slight nodular infiltration in lower one-third of each lung Clinical diagnosis sarcoid Biopsy of skin nodules sarcoid A G ratio 3.7:3.3 Two years later, chest clear, but skin and eye lesions unchanged

Summary A young negro with chronic ocular and cutaneous sarcoidosis and transient pulmonary and parotid disease (Two year follow-up)

CASE 13 R G, white, male, 28 "Sore eyes" for six months Treated for chronic right iritis Roentgen findings hilar and right mediastinal adenopathy, slight pulmonary congestion or infiltration Hands and feet negative Clinical diagnosis possible tuberculosis Three months later, chest and eye improved Five months later, eye negative, hilar adenopathy improved, parenchymal infiltrate extending Two years later, caught cold Chest x-ray interpreted (elsewhere) as far advanced tuberculosis Multiple sputum and other tests negative. Clinical diagnosis tuberculosis or lymphogranuloma

Despite the absence of palpable nodes, Drs D L Wilbur and A C Daniels explored the right upper mediastinum through a small supraclavicular incision, a slightly enlarged node was found Biopsy sarcoid Two years later, the diffuse lesions had coalesced to massive upper lobe densities A G ratio 4.5:3.05

Summary A young white male with transient sarcoidosis of the eyes and chronic lesions of the

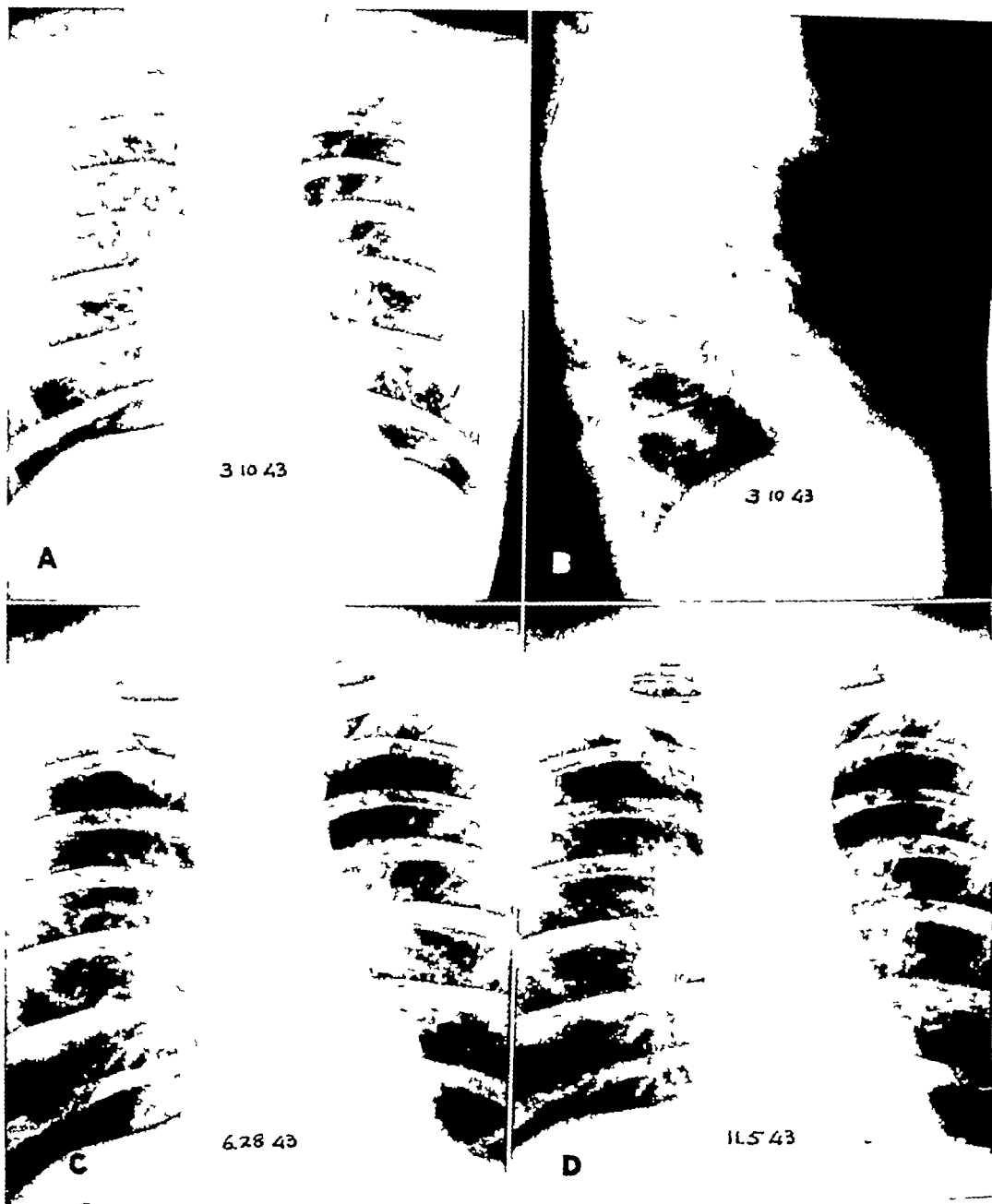


Fig 4 (A-D) Case 13 Pulmonary sarcoidosis. Classical course first with regression then with progression and fibrosis. White male 28 with iritis right chronic. Positive node biopsy. A Bilateral hilar and right paratracheal adenopathy with minimal pulmonary infiltrate. B Lateral view of same. C Adenopathy diminished nodular infiltrate extending. D Slight improvement. See also Fig 4 (E-H).

lungs repeatedly diagnosed by different physicians as advanced tuberculosis (Four year follow up)

CASE 14 P B, white, male, 34 Generalized painless swellings (adenopathy) for three years. Enlarged nodes in neck axillae, and groins 1 to 6 cm in diameter. Roentgen findings slight hilar

and right paratracheal adenopathy. Clinical diagnosis lymphoblastoma. Biopsy of a cervical and an epitrochlear node sarcoid. Course unchanged one month later.

Summary A white male with peripheral and mediastinal lymph node sarcoidosis.

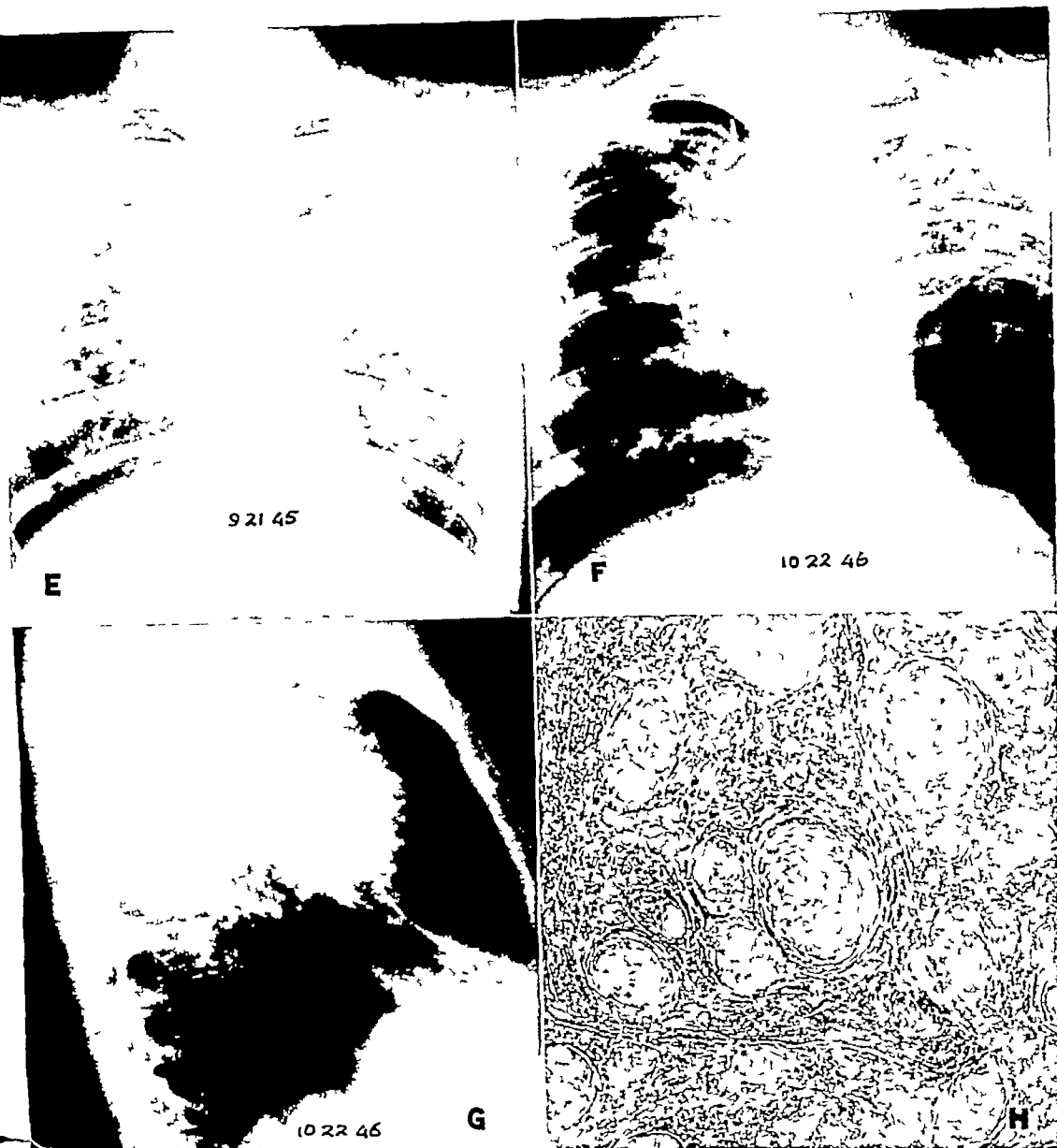


Fig 4 (E-H) E Adenopathy apparently gone but extensive nodular infiltrate in both lungs especially in the upper halves F Coalescent fibrotic and nodular lesions in upper lung fields mediastinal pleural thickening G Lateral view of same H Section of node obtained by supraclavicular fossa search, showing multiple discrete non-caseating tubercles and giant cells (March 1943 to October 1946)

CASE 15 M S, colored female, 23 Small lump in right upper eyelid for four months Previous cervical lymphadenopathy Roentgen findings bilateral hilar and left paratracheal adenopathy, lung parenchyma clear Clinical diagnosis granuloma Biopsy of upper lid nodule chronic granuloma (sarcoid) Course sixteen months later improved

Summary Puerto Rican female with cutaneous and lymph node sarcoidosis

CASE 16 E S, white, female, 29 Right facial palsy, one week Bilateral parotitis Left pupil irregular (uveitis) Plasma protein 67 per cent Roentgen findings chest negative Biopsy of parotid swelling sarcoid Three weeks later, slight hilar adenopathy Two months later, slight right paratracheal adenopathy, unchanged after another two months Two years after the initial examination, chest was again negative

Summary White female with multiple system



Fig 4 (A-D) Case 13 Pulmonary sarcoidosis Classical course first with regression then with progression and fibrosis White, male 28 with iritis right chronic Positive node biopsy A Bilateral hilar and right paratracheal adenopathy with minimal pulmonary infiltrate B Lateral view of same C Adenopathy diminished nodular infiltrate extending D Slight improvement See also Fig 4 (E-H)

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CASE 14 P B, white, male, 34 Generalized painless swellings (adenopathy) for three years Enlarged nodes in neck, axillae, and groins 1 to 6 cm in diameter Roentgen findings slight hilar

and right paratracheal adenopathy Clinical diagnosis lymphoblastoma Biopsy of a cervical and an epitrochlear node sarcoid Course unchanged one month later

Summary A white male with peripheral and mediastinal lymph node sarcoidosis

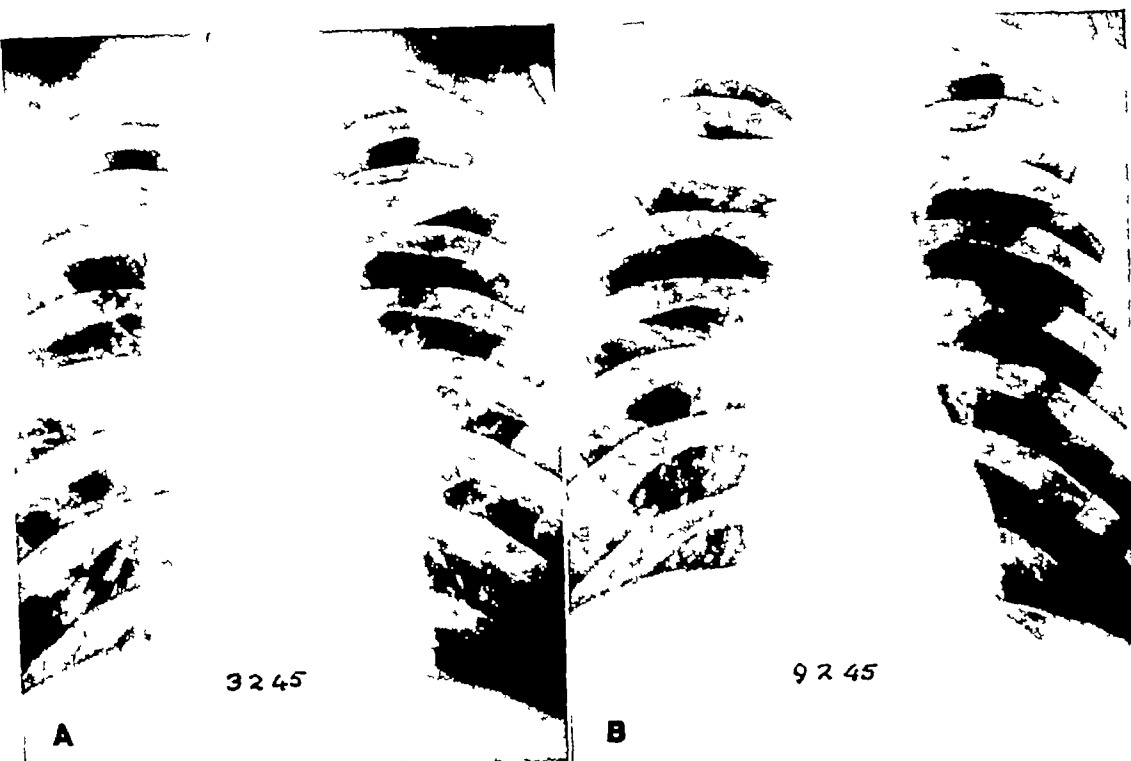


Fig 7 Case 20 A Sarcoid type adenopathy with mediastinal effusion, bilateral pulmonary nodular infiltrate Node biopsy positive No symptoms Case found on routine chest survey B Marked improvement approximately six months later

pulmonary haziness Hands coarse phalangeal trabeculations Clinical diagnosis possible sarcoidosis Biopsy of right parotid sarcoid Course slight improvement two months later

Summary Young negro with generalized sarcoidosis

CASE 23 J H, colored, male, 18 No symptoms Routine annual chest survey disclosed bilateral hilar and right paratracheal adenopathy, with nodular infiltration of both lungs Biopsy of node from left supraclavicular fossa sarcoid Relatively heavy irradiation of the chest at another hospital (1,100 r, in air, to anterior and posterior fields 15×15 cm) One month later, no change

Summary Young negro with extensive, silent intrathoracic sarcoidosis

CASE 24 J A, colored, male, 26 Abdominal pains, chronic, intermittent Nodular eruptions on face, eyelids, elbows, and shins Corneal opacity, left eye (mild uveitis) Roentgen findings bilateral hilar and right paratracheal adenopathy Clinical diagnosis possible appendicitis Biopsy of skin nodule and inguinal node sarcoid The abdominal pain cleared up spontaneously, but seven months later, the chest findings were unchanged.

Summary Negro with definite intrathoracic ocular, and cutaneous sarcoidosis and probable abdominal node sarcoids, with transient symptomatic mesenteric adenitis

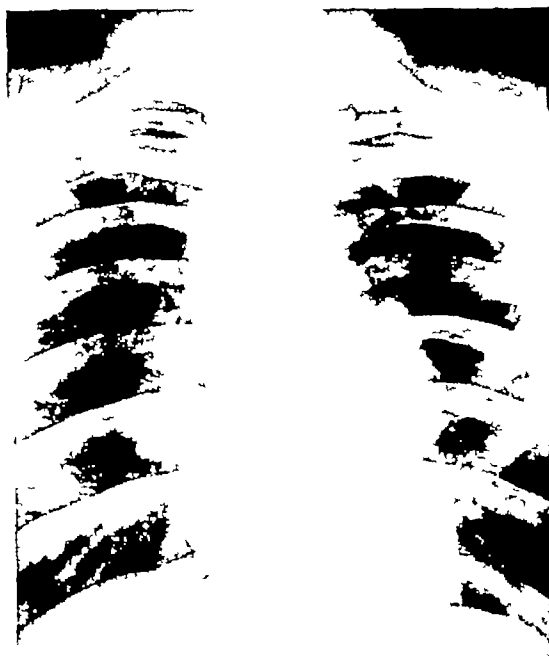


Fig 8 Case 21 Sarcoid type adenopathy (hilar and right paratracheal) with questionable slight pulmonary nodulation Node biopsy positive No symptoms Case found on routine survey

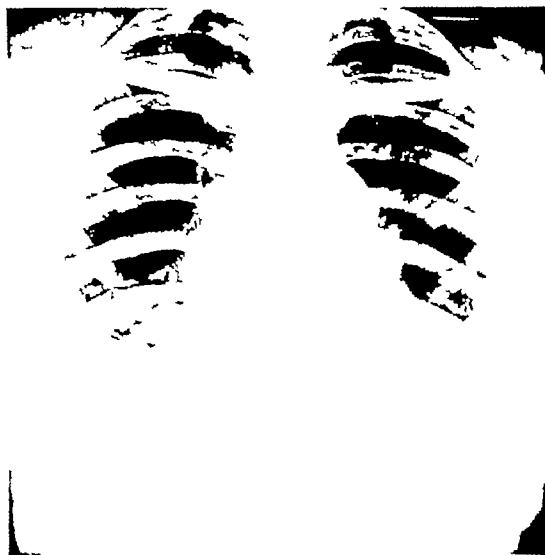


Fig 5 Case 16 Early sarcoidosis (slight hilar and right paratracheal adenopathy) Chest film three weeks previously, negative White female 29, with right facial palsy Parotid biopsy positive Subsequent development of right paratracheal adenopathy Two years later clear

sarcoidosis, showing spontaneous improvement (Two-year follow up)

CASE 17 C J, colored, male, 26 Cough and slight pain in chest for one week Examination revealed generalized lymphadenopathy, skin rash, enlarged liver Roentgen findings bilateral pulmonary infiltrate, 'fibrotic' type Clinical diagnosis pneumonitis Biopsy of right epitrochlear node and left forearm skin nodule sarcoid A G ratio inverted One year later, improved

Summary Colored male with generalized sarcoidosis and only slight transient pulmonary symptoms, possibly due to coincidental infection

CASE 18 M K, white, female, 56 Abdominal distress after meals for one year Subcutaneous nodules on arms and legs, chest pain and sneezing episodes for two weeks Roentgen findings bilateral pulmonary infiltration, fibrotic type Hands slight cyst like lesions in four phalanges Clinical diagnosis possible gastro intestinal neoplasm Biopsy of subcutaneous nodule from left thigh sarcoid Three years later, lungs almost clear

Summary White female with mild generalized chronic sarcoidosis (Three year follow up)

CASE 19 J W, colored, male, 19 Asymptomatic Small epitrochlear nodes found on routine physical examination, shortly afterwards, axillary nodes palpable, a few skin nodules appeared Roentgen findings bilateral hilar and right paratracheal adenopathy, perihilar infiltration Mantoux, positive Biopsy of axillary node and skin

nodule sarcoid Moderate course of radiation to chest (700 r, in air, anterior and posterior fields) No immediate change, lost to present follow up

Summary Young negro with generalized sarcoidosis, apparently early and virtually silent



Fig 6 Case 19 "Sarcoid type" adenopathy Bilateral hilar and right paratracheal adenopathy slight perihilar infiltration Node and skin biopsy positive. No symptoms

CASE 20 M B, colored, male, 23 No symptoms, routine chest x ray disclosed intrathoracic disease Following this physical examination revealed a few small palpable nodes Roentgen findings bilateral hilar and right paratracheal adenopathy, nodular pulmonary infiltration Sputum repeatedly negative for acid fast bacilli Biopsy of node sarcoid Moderate dose of radiation to chest (800 r, in air anterior and posterior fields) Six months later, patient much improved

Summary Young negro with mild asymptomatic sarcoidosis, regressing

CASE 21 M W, white, male, 24 No symptoms Routine chest survey Roentgen findings bilateral hilar and right paratracheal adenopathy, questionable slight pulmonary infiltrate Biopsy of posterior cervical node sarcoid Small dose of radiation to chest (400 r in air, anterior and posterior fields) Two months later no change.

Summary Silent sarcoidosis stationary in young white male.

CASE 22 E McC colored male 19 Cough for one year, chest pain for one month Testes sore, left eye red and painful for one month Parotid glands palpable Roentgen findings bilateral hilar and right paratracheal adenopathy questionable

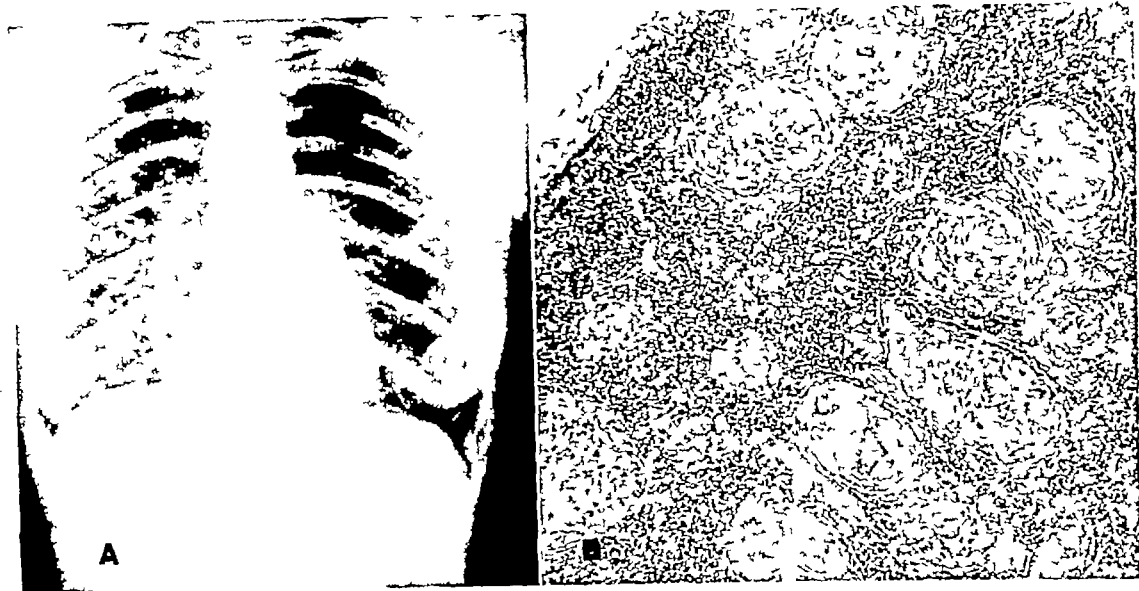


Fig 10 Case 28 A Early sarcoidosis (disseminated nodular lesions in most of right lung and in parts of left) Chest films made several weeks and months previously negative White female, 27, in excellent physical condition, with slight dry cough for four weeks Node biopsy positive. B Section from node showing multiple discrete, non-caseating tubercles, no visible asteroid bodies, multiple giant cells

for eighteen months, with sputum always negative Recently skin lesions developed over body and extremities, and a few enlarged peripheral nodes Roentgen findings bilateral, diffuse nodulofibrotic lesions in lungs, with bullous-like areas in left upper lobe Clinical diagnosis tuberculosis or sarcoidosis Biopsy of node from left axilla and skin from plaque on back sarcoid. A G ratio 3 58 5 42 Eight months later, unchanged

Summary Colored female with pulmonary and cutaneous sarcoidosis, chronic

CASE 34 L C, white, female, 27 Slight weight loss and asthenia for seven months Tuberculin test and sputum reported positive on one occasion at a private sanatorium, but negative six times under our observation Examination of gastric washings negative on three occasions Coccidioidin test negative No fever Reversed A G ratio Roentgen findings bilateral pulmonary infiltration, central three quarters of each lung, slight right hilar adenopathy Few small calcific densities in right apex Biopsy of small right cervical node inflammatory tissue Three months later, patient clinically well, roentgen findings unchanged.

Summary White female with probable chronic pulmonary sarcoidosis, and possible obsolete right apical re infection type tuberculosis

CASE 35 D W, colored female, 38 "Cold in chest" for two weeks Slight generalized adenopathy Slight scarring of some skin areas from "old rash" Roentgen findings bilateral hilar and right mediastinal adenopathy Clinical diagnosis lymphosarcoma Sternal bone marrow puncture nega-



Fig 11 Case 30 Sarcoidosis, "potato node" type probably early Bilateral hilar adenopathy, slight pulmonary nodulation Node biopsy positive No symptoms Case found on routine chest survey

tive for tumor not studied for possible sarcoids, specimen unavailable at this time A G ratio 3 58 4 72 All tests for tuberculosis, etc, negative Final diagnosis after prolonged clinical study, sarcoidosis Patient lost to follow up

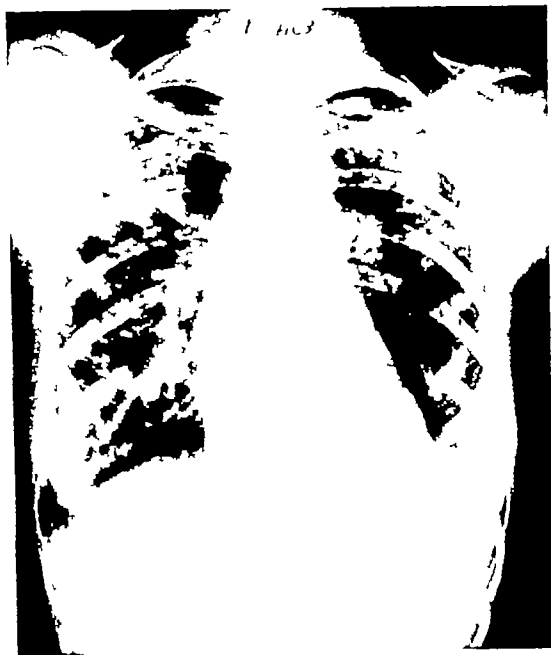


Fig 9 Case 26 Sarcoidosis. Nodular and coalescent densities in upper two-thirds of each lung, small left basal effusion. Node biopsy positive.

CASE 25 M B, white, female, 74. Intestinal obstruction. Roentgen findings: slight hilar adenopathy, lungs clear. Obstructive sigmoid lesion. Development of peritonitis and death. Necropsy: carcinoma of sigmoid, hilar adenopathy (microscopically, sarcoidosis).

Summary: An elderly white female with cancer of the colon and, purely incidental asymptomatic mediastinal node sarcoidosis.

CASE 26 R J, colored, female, 30. Dysuria and abdominal pain for one month, gonorrheal urethritis. Roentgen findings: patchy densities and nodular lesions in upper two thirds of each lung. Lymphadenopathy developed on the ward. Biopsy of left epitrochlear node: sarcoid. Three months later, lungs improved, two months later, lungs unchanged, left basal pleural thickening developed.

Summary: Negress with silent pulmonary sarcoidosis, peripheral sarcoid adenitis developing during treatment for gonorrheal salpingitis.

CASE 27 L B, colored, male, 23. Abdominal pain for two weeks. Cough and slight fever developed while patient was under medical observation. Roentgen findings: bilateral hilar and right paratracheal adenopathy, nodular pulmonary infiltration. Biopsy of node: sarcoid. Moderate radiation to the mediastinum (800 r, in air anterior and posterior). Six months later, no change.

Summary: Negro with silent pulmonary sarcoidosis and probable symptomatic abdominal node sarcoids.

CASE 28 H P, white, female, 27. Slight dry cough for four weeks. Routine chest film disclosed extensive nodular infiltration of the entire right lung, and very slight nodulation of the left lung. In view of patient's excellent general status, a roentgen diagnosis of sarcoid was suggested. *Note:* This patient had chest films six months, one year, and three years previously, all reported by competent observer as negative. Hands negative. Biopsy of a small right cervical node: sarcoid. Course unchanged.

Summary: A physician's wife with asymptomatic pulmonary sarcoidosis.

CASE 29 J D, colored, female, 22. Pain in left costovertebral angle for two weeks, moderate anemia, splenomegaly, scalp lesions on legs. Roentgen findings: bilateral hilar adenopathy with slight pulmonary nodulation. Hands: coarse trabecular pattern in phalanges and metacarpals (questionable sarcoid myelosis). Clinical diagnosis: infarct. Biopsy of skin nodule: sarcoid. One month later, improved.

Summary: Colored female with abdominal (notably splenic), thoracic, and cutaneous sarcoidosis.

CASE 30 H H, colored, male, 22. No symptoms. Abnormal densities found on routine chest film at separation center. Roentgen findings: bilateral hilar adenopathy, slight pulmonary nodulation. Tuberculin 1:10,000 positive. Sputum negative. Biopsy of cervical node: sarcoid. Course not known.

Summary: Silent pulmonary sarcoidosis in young negro.

CASE 31 E W, white female, 50. Dyspnea on exertion and precordial pain for one year. Slight splenomegaly. Roentgen findings: bilateral hilar and right paratracheal adenopathy, slight infiltration or lobular atelectasis in middle third of right lung. A/G ratio 3:71:2:99. Clinical diagnosis: cardiovascular disease. Biopsy of a small right cervical node: sarcoid. Course: no change after one month.

Summary: Middle aged white female with incidental, silent pulmonary sarcoidosis and possible myocardial sarcoidosis.

CASE 32 M M, white female, 24. Pain in abdomen for twelve days. Slightly enlarged liver and spleen. Roentgen findings: diffuse miliary lesions in both lungs. Clinical diagnosis: deferred. Course: some small inguinal nodes developed, one was removed and revealed sarcoid on section. One month later, chest unchanged, patient clinically well. (Case reported by courtesy of Drs. E. E. Simpson and C. E. Grayson of Sacramento.)

Summary: Young white female with silent pulmonary sarcoidosis and possible abdominal node sarcoids.

CASE 33 I C, colored female, 48. Cough and dyspnea for three years. In tuberculosis sanatorium

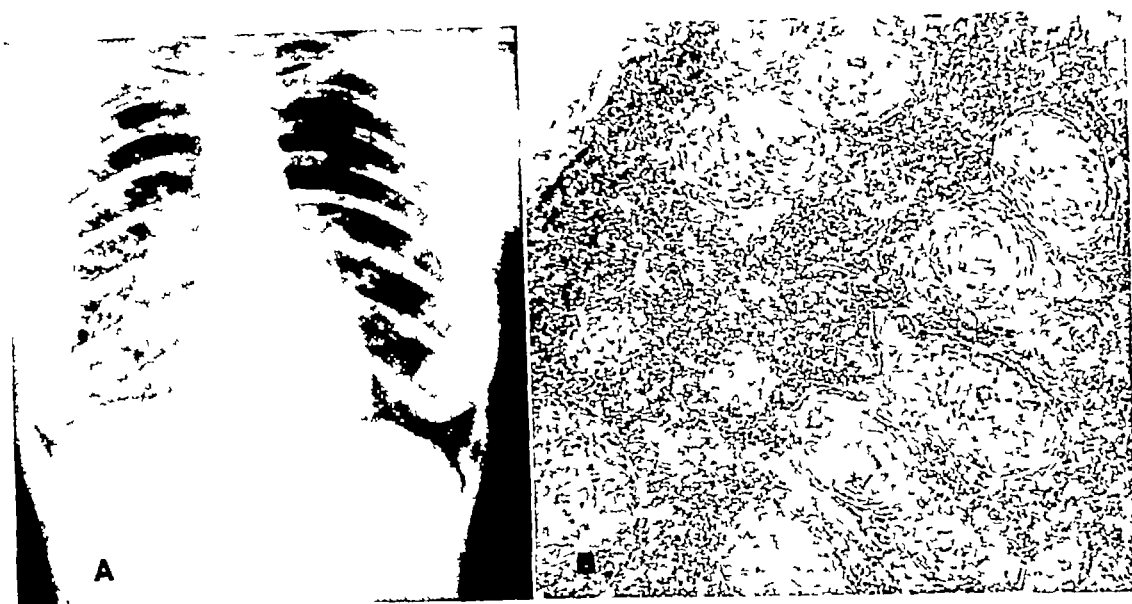


Fig 10 Case 28 A Early sarcoidosis (disseminated nodular lesions in most of right lung and in parts of left) Chest films made several weeks and months previously negative White, female, 27, in excellent physical condition, with slight dry cough for four weeks Node biopsy positive. B Section from node showing multiple discrete, non caseating tubercles, no visible asteroid bodies, multiple giant cells

for eighteen months, with sputum always negative. Recently skin lesions developed over body and extremities, and a few enlarged peripheral nodes. Roentgen findings bilateral, diffuse nodulofibrotic lesions in lungs, with bullous like areas in left upper lobe. Clinical diagnosis tuberculosis or sarcoidosis. Biopsy of node from left axilla and skin from plaque on back sarcoid. A G ratio 3.58:5.42. Eight months later, unchanged.

Summary Colored female with pulmonary and cutaneous sarcoidosis, chronic

CASE 34 L C, white, female, 27. Slight weight loss and asthenia for seven months. Tuberculin test and sputum reported positive on one occasion at a private sanatorium, but negative six times under our observation. Examination of gastric washings negative on three occasions. Coccioidin test negative. No fever. Reversed A G ratio. Roentgen findings bilateral pulmonary infiltration, central three quarters of each lung, slight right hilar adenopathy. Few small calcific densities in right apex. Biopsy of small right cervical node inflammatory tissue. Three months later, patient clinically well, roentgen findings unchanged.

Summary White female with probable chronic pulmonary sarcoidosis, and possible obsolete right apical re infection type tuberculosis

CASE 35 D W, colored, female, 38. 'Cold in chest' for two weeks. Slight generalized adenopathy. Slight scarring of some skin areas from 'old rash'. Roentgen findings bilateral hilar and right mediastinal adenopathy. Clinical diagnosis lymphosarcoma. Sternal bone marrow puncture nega-



Fig 11 Case 30 Sarcoidosis, 'potato node' type, probably early. Bilateral hilar adenopathy, slight pulmonary nodulation. Node biopsy positive. No symptoms. Case found on routine chest survey

tive for tumor. not studied for possible sarcoids, specimen unavailable at this time. A G ratio 3.58:4.72. All tests for tuberculosis, etc., negative. Final diagnosis after prolonged clinical study, sarcoidosis. Patient lost to follow-up.

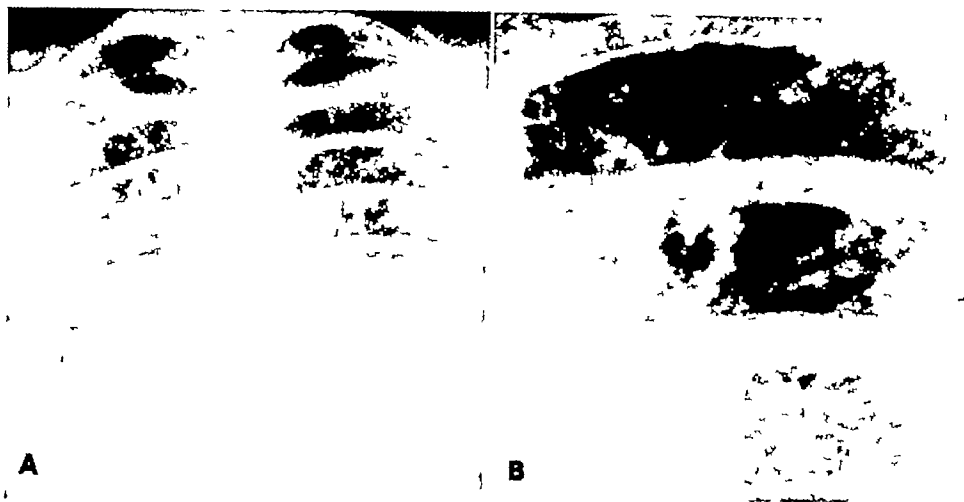


Fig 12 Case 32 A Sarcoidosis miliary type probably early Diffuse miliary lesions in both lungs Node biopsy positive White female 24 with abdominal pain for 12 days Lung changes found at fluoroscopic examination of the alimentary tract B Miliary lesions in left upper lung field

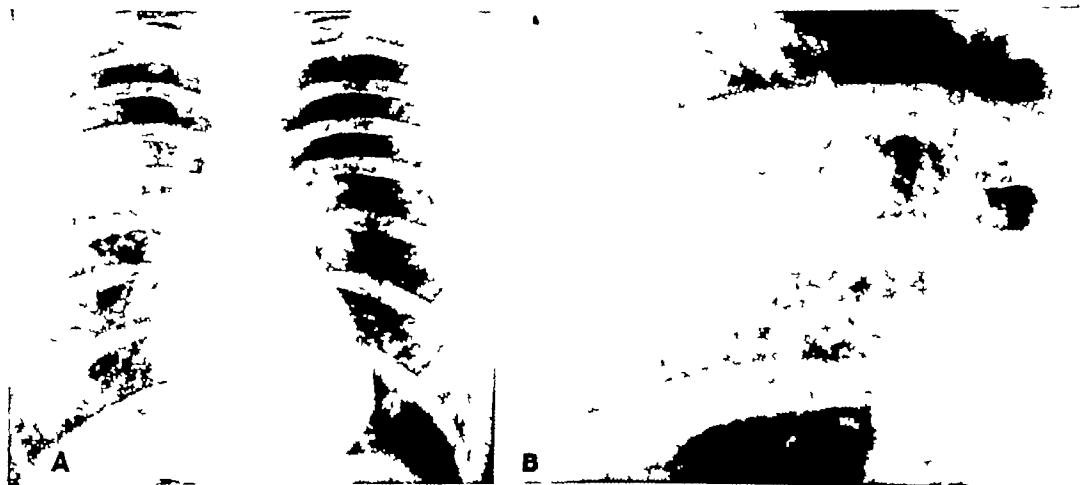


Fig 13 Case 36 A Sarcoidosis nodular type early Disseminated nodular lesions in middle two thirds of each lung White female 23 with transient mild dysphagia Lung changes found at fluoroscopic examination of the esophagus B Nodular lesions in right upper lung field

Summary Colored female with sarcoidosis of the mediastinal nodes and probable old sarcoids of the skin

CASE 36 L M, white female 23 Slight dysphagia for one week, otherwise perfectly well and active Roentgen findings esophagus and stomach negative, disseminated pulmonary nodular lesions middle two thirds of each lung All tests negative Exploration of right supraclavicular fossa refused Clinical diagnosis sarcoidosis Two months later, patient clinically well but chest film unchanged

Summary White female with pulmonary sarcoidosis, asymptomatic

SUMMARY

The most frequent type of sarcoidosis encountered clinically is one with hilar lymphadenopathy and pulmonary infiltration. An increasing number of such cases are being discovered in routine chest surveys and are being interpreted as tuberculosis, Hodgkin's disease, mediastinal tumor, and other entities. It is desirable that the possibility of sarcoidosis be kept in mind in such instances, and the attempt

made to establish the correct diagnosis by microscopic examination "Sarcoidosis should be considered in the differential diagnosis of all cases of chronic painless lymphadenopathy, whether there are demonstrable lesions of the skin, bones and lungs or not. The diagnosis is not established by pathological examination alone, but only in conjunction with the appropriate clinical and bacteriological evidence to eliminate other granulomatous infections" (5)

A palpable lymph node or skin nodule is the most desirable tissue for microscopic examination. However, when *none* such is evident, exploration of the mesial end of the right supraclavicular fossa through a short incision will frequently yield an *upper anterior mediastinal node* for study and positive diagnosis.³

In the absence of microscopic evidence of non-caseating tubercles, there are certain roentgen findings suggestive, but not pathognomonic, of the disease. These include extensive bilateral nodular parenchymal densities in persons having no symptoms of disease, and especially the combination of nodular densities with bilateral hilar and right paratracheal adenopathy. Grossly enlarged hilar nodes alone, in an apparently healthy person, are also a highly suggestive sign.

Absence of pulmonary involvement at one stage of sarcoidosis is no assurance it will not be silently present months or years later. The course of a given case is usually quite unpredictable. The lesions may regress, remain stationary, or progress without apparent reason. This renders estimation of the beneficial effects of therapy, such as roentgen irradiation, extremely difficult. Some cases progress to diffuse, coalescent pulmonary fibrosis, with variable degrees of cardiac embarrassment. Only one of our cases appeared to show such a complication. In some, coincidental tuberculosis develops, one of our patients has calcified lesions in one pulmonary apex (pre-existing obsolete tuberculosis?), none has developed frank phthisis to date.

³ Daniels A J, and Wilbur, D L. To be published

Cerebral, meningeal, or cardiac involvement may lead to a fatal outcome. This could not be proved in any of our cases.

CONCLUSIONS

The *early* roentgen finding in pulmonary sarcoidosis may be one of four types

- 1 Disseminated miliary parenchymal lesions,
- 2 Diffuse or localized nodular parenchymal lesions,
- 3 Parenchymal densities with hilar and paratracheal adenopathy,
- 4 Hilar and paratracheal adenopathy alone

This adenopathy is present in about two-thirds of the early cases, and is usually of a pattern we have designated "sarcoid-type," consisting of bilateral hilar and right paratracheal lymph node enlargement.

The miliary type of pulmonary sarcoidosis occurred as an early finding in a minority of our cases.

ACKNOWLEDGMENT The writer is indebted to Dr B R Kennedy for invaluable assistance in compiling the data on many of the cases reported in this paper, to Dr R R Newell for permission to review the films of eleven cases from the Stanford University Hospital x-ray files, to Dr R S Stone for similar permission in connection with four cases from the University of California Hospital x-ray files, to Drs S F Thomas and C L Boice for assistance in locating some of the cases seen while they and the author were on duty at the U S Naval Hospital, Oakland, Calif, and, finally, to the many physicians who aided with clinical and other data on the cases under review.

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DISCUSSION OF SYMPOSIUM ON DISEASES OF THE CHEST

(Papers by Wm Dock Horace W Jamison and Ray A Carter, and L Henry Garland)

Leo G Rigler, M D (Minneapolis, Minn) Dr Dock's very interesting paper was most satisfying to me, since I am one of those 'old fashioned' people who have been trying to oppose the trend to treat minimal tuberculosis rather casually and who still believe in complete bed rest for the earliest tuberculous lesion Dr Dock's theory of course, tends to push us in that direction As he himself said, however, the experimental proof of his theory is still to be obtained, although he has built up a very satisfactory, logical type of case

I think it should be said that pressures in the pulmonary circulation are subject to considerable differences and that one cannot make inferences or transfer observations from the peripheral circulation or from other data, since there are apparently a lot of compensatory mechanisms in the pulmonary circulation of which we understand very little

For instance, if you have an arteriovenous fistula of the peripheral circulation, you will get a prompt increase in the size of the heart If you have an aneurysm or fistula in the pulmonary circulation, apparently nothing happens to the heart, some sort of compensatory mechanism is in evidence. So that it is necessary to prove unequivocally these changes in pressure, although the case certainly has a most logical and attractive sound

We know very little about coccidioidomycosis in Minnesota Fortunately it has not yet invaded us except by way of information which we get from our staff who were incarcerated in sunny and dusty California during the war and brought back a lot of data about it I'm afraid I cannot comment adequately upon it

Dr Garland's presentation on the problem of sarcoidosis, while illuminating and comprehensive, was disappointing When I saw the title I was confident that an investigator of our Chairman's talents would surely give us the answer to the problems in the early diagnosis and differentiation of sarcoidosis Unfortunately, Dr Garland has no magic formula, although he has beautifully oriented and clearly enunciated the picture of the findings

His conclusions differ in no respect from those that we have come to from our experience I should like to add a word to his criteria in the typical case—that is, a bilateral hilar adenopathy and a right paratracheal lymph node enlargement—so that it becomes *symmetrical* bilateral hilar adenopathy, because I think, in the classical cases he showed, symmetry is a very striking thing I would like to ask Dr Garland if he has had any experience with the skin test for sarcoidosis made by grinding up a lymph node and also whether he has any information with regard to the more recent bacteriological studies of such lymph nodes

W Edward Chamberlain, M D (Philadelphia) I was fascinated by Dr Dock's presentation. I very modestly calls it speculative but I would say that, while the evidence is circumstantial, circumstantial evidence can sometimes be quite devastating I find his ideas extremely stimulating and exciting

Dr Garland, I believe, made a point that I would like to emphasize—that when we begin to x-ray large numbers of apparently healthy persons, we begin to have a better understanding of sarcoidosis or at least to find out something about it Before we began to do mass surveys or to examine large numbers of men on induction or release from active military or naval service, we had an erroneous impression of the symptomatology of sarcoidosis because we saw only the sick individuals There has been a particularly high incidence of the big 'potato nodes' mentioned by Dr Garland in these mass surveys Plaingraphic studies in such cases reveal something very interesting, namely, a complete absence of narrowing of the bronchial airway through

the massive node. And that, of course, provides us with a very striking differential feature from neoplastic masses of similar size. I must say that we feel justified in going pretty far toward a definite diagnosis of sarcoidosis when we find this complete absence of narrowing of the airways in these nodes.

In connection with Dr Jamison's paper, I recalled a rather astonishing case of laboratory infection which came to the attention of Dr Dock, Dr Garland, Dr Newell, and myself back in 1932 or 1933. One of our medical students, playing around with an old dry culture of *Coccidioides immitis*, looked up and saw some fuzz floating in the air in front of him. Frightened, he closed the test tube and forgot about it. A couple of weeks later he complained of a chest condition which looked like tuberculosis and which Dr Newell and I thought was tuberculosis. Subsequently an erythema nodosum appeared and a little later a pure culture of *Coccidioides immitis* was obtained from the young man's sputum. In those days we had no knowledge of the nature of valley fever or of any form of coccidioidomycosis which was not fatal, and we waited for our student to die. He surprised us all by promptly getting well, and a few years later, when we discovered the bacteriological basis for valley fever, we were able to understand his beautiful recovery much better than was possible at the time.

George M Wyatt, M D (Washington, D C) I plan to limit my discussion largely to sarcoidosis but I should first like to state that coccidioidomycosis is a real diagnostic problem for those of us in the East, where it is seen so rarely that it is difficult to keep it in mind as a possibility. We had one patient who had never been in California but contracted coccidioidomycosis while cleaning an airplane which had recently come from that state.

In regard to sarcoid, it is my belief that the most significant and diagnostic single finding, and the one which has been heavily emphasized by Dr Rigler, is the bilateral symmetry of the lymph node enlargement. If measurements are made from the midline, you will find that the nodes extend equal distances from the midline almost to the millimeter. The right paratracheal nodes, of course, show enlargement without corresponding enlargement of the left because they are the only unpaired lymph nodes in the chest. In a recent conversation, Dr Harry Hauser informed me that he had also encountered the symmetrical enlargement quite constantly.

I saw approximately 150 cases of sarcoid while at the Walter Reed Hospital in Washington. Because that hospital was a tumor center, many of these patients came with a diagnosis of lymphoma. Our impression, therefore, of the more common change was that of lymphadenopathy. In our experience bone involvement was extremely rare. Only one patient had any demonstrable bone lesions, although a search for these was made in every case.

We did not recognize osteoporosis in any of these patients.

Erythema nodosum is either the same disease as sarcoid, or the chest manifestations of the two diseases are exactly alike, for the roentgenogram permits no differentiation between the two. Miliary sarcoid may exactly simulate miliary tuberculosis, but the patient with miliary tuberculosis does not usually walk into the office, he is carried in.

There is one question that I should like to ask Dr Garland. Should we call the lesions he has demonstrated early or minimal? We have seen some cases in which there was first adenopathy which receded with the appearance of miliary lesions in the lung parenchyma. Then the miliary lesions receded and the lymph nodes again enlarged. When you have that "coming" and "going," it is somewhat difficult to tell what is coming and what is going.

R R Newell, M D (San Francisco) Dr Jamison and Dr Carter have had an extraordinary opportunity for a broad experience with coccidioidal infection in this geographically limited disease. Dr Jamison stressed the variation in the roentgen appearance of coccidioidal infection in the lung and then he showed us several cases with quite typical appearance, imitating virus fever. I have seen this disease imitate bronchopneumonia, Friedländer's pneumonia, and even metastatic cancer. We had one case which developed an appearance of miliary tuberculosis that cleared up in the course of a few weeks, so that one realized that it was not a generalized miliary spread of the disease but was merely many small coccidioidal tubercles within the lung. We classified this case as primary, for it did not go on to the grave granulomatous phase.

The development of these solitary granulomas, these round spots, is very interesting and happens much more often in coccidioidal infection than it does in tuberculosis. They resemble what we have been calling, in tuberculosis, mummular tuberculosis or Assmann foci. I was glad to see Dr Jamison classify them as primary. They are granulomas, to be sure, but when one says "coccidioidal granuloma," he ordinarily means the stage of the disease with metastatic granulomatous lesions, the stage which shows a mortality of 50 per cent, a very different matter from the primary stage, which is so very usually benign, as these mummular lesions are benign.

In one case of primary coccidioidal infection, we have watched the development of a solid lesion in the lower lobe which has remained practically unchanged in roentgen appearance for over three years.

Dr Garland (closing) In reply to Dr Rigler's question, Dr Carnes at Stanford has performed many skin tests on patients, and made bacteriological studies on removed lymph nodes, but without

conclusive results to date, we still don't know whether or not the disease is due to a virus

In reply to Dr Chamberlain, one of Dr Snapper's original cases and one of ours were diagnosed bronchogenic carcinoma at the initial examination. The enlarged hilar nodes do sometimes cause atelectasis, although I quite agree that this is exceptional.

In reply to Dr Wyatt, it is possible that a preferential title would have been "minimal" rather than "early." However, some of the cases which we saw were, in our opinion, unquestionably *early*, most may have been minimal. I cannot agree as to the

symmetrical nature of the hilar adenopathy, it was seldom truly symmetrical in our cases. Nevertheless, the large number of cases which Dr Wyatt saw at Walter Reed Hospital entitle him to a "senior" view on this point! I suspect that bone lesions in sarcoid are like the nodal ones, you've got to catch them when they happen to be evident. They may be present for one six month period and then not demonstrable for months or years, only to reappear later. In our experience, the diffuse, faint porotic type of change is commoner in the phalanges than the classical cystic form.



Roentgen Therapy in Hodgkin's Disease¹

T B MERNER, M.D., and K. W. STENSTROM, Ph.D

Minneapolis, Minn.

THE RAPID response of the lymphoblastoma group to x-ray therapy has been well known for many years. Since the lesions originate in lymphoid cells, which are the most sensitive of all body cells to roentgen rays, lymphoblastomas themselves are also very sensitive (1).

Certain radiologists would treat these lesions with very light dosages because they are impressed by the good temporary response. Others would give intensive treatment, approaching dosages used for carcinoma. It is likely that the most satisfactory response is obtained somewhere between the two extremes.

The method of treatment which has been used at our clinic produces results which, when analyzed, compare very favorably with others so far published. It is our purpose to present statistical data obtained from our records which will give a fairly accurate idea concerning the effectiveness of this method.

A series of 185 cases proved by biopsy will be presented. The biopsy specimens were examined by the Department of Pathology, under the supervision of Dr. E. T. Bell. Another group of 53 cases has been analyzed, in which biopsy specimens were examined elsewhere and considered to show the features of Hodgkin's disease. The slides, however, were not available for confirmation. Clinically the lesions in this group strongly indicated the presence of Hodgkin's disease, although we cannot claim them as proved cases. All cases treated in this department from 1926 through 1942 are included and have been followed to the end of December 1945.

HISTORY

The most commonly recognized of the lymphoblastoma group, Hodgkin's dis-

ease, took its name from the man who first recognized it in 1832 as a clinical entity, Sir Thomas Hodgkin (2). Seven cases of lymphadenopathy, accompanied by anemia and splenomegaly followed by cachexia and death, were described by him. He felt that the disease was a primary affection of the lymph nodes rather than some secondary infection. Most of the cases described by Hodgkin are now believed to have been tuberculosis or neoplasm, but at least 2 were true examples of what we recognize as Hodgkin's disease. Tissues from one of these cases are still preserved in the museum of Guy's Hospital and have been proved by Herbert Fox (3), with modern microscopic technique, to have the characteristic histologic structure.

In 1856 Sir Samuel Wilks (4) added to the original description of Hodgkin and pointed out the frequent involvement of liver, kidneys, and lungs. He clearly distinguished Hodgkin's disease from the leukemias. No detailed description of the microscopic pathology was given until Greenfield (5) referred to the chronic inflammation, marked increase in fibrous stroma, and large number of multinucleated cells.

Goldmann (6), in 1892, pointed out the importance of eosinophils, and in 1898 Sternberg (7) described the characteristic giant cells and areas of necrosis. Reed (8), in 1902, correlated the pathological findings with the clinical histories. She gave a more accurate description of the cells than Sternberg and recognized their importance in the diagnosis. The following conclusions were reached by her after extensive studies.

1 We should limit the term Hodgkin's disease to the designation of a clinical and pathological entity, the main features of which are painless pro-

¹ From the Department of Radiology and Physical Therapy of the University of Minnesota and the University Hospitals, Minneapolis, Minn. Accepted for publication in July 1946.

gressive glandular enlargement, usually starting in the cervical regions without the blood changes of leukemia

2 The growth presents a specific histologic picture, not a simple hyperplasia but changes suggesting a chronic inflammatory process

3 The microscopic examination is sufficient for a diagnosis. An inoculation may confirm the diagnosis by its negative results [written when the tuberculous nature of the disease was upheld by many]

4 Eosinophils are usually present in great numbers in such growths but not invariably. Their presence strengthens the diagnosis

5 The causative agent is as yet undiscovered. Tuberculosis has no direct relationship to the subject

Wallhauser (9) found about fifty synonyms for Hodgkin's disease, demonstrating the confusion regarding classification and etiology. In Germany, the usual designation has been lymphogranuloma. This term is undesirable until more is known about the true nature of the disease. It is also confusing, since there are other types of lymphogranuloma, such as mycosis fungoides, Kaposi sarcoma, Boeck's sarcoid, etc. In America, the term malignant has been added to differentiate it from the other lymphogranulomas, on the assumption that the disease is neoplastic. Mallory (10), one of the principal advocates of the neoplastic nature of Hodgkin's disease, calls it "lymphoblastoma." Other terms used on occasion are "malignant lymphoma," "megakaryoblastoma," lymphoma, and lymphadenoma. The last term seems to be favored by the British. (These names are, however, used in a wider sense and include other entities.)

To avoid confusion, the term "Hodgkin's disease" is by far the most desirable, since it preserves the condition as a distinct entity apart from the other members of the same large group. Krumbhaar (11) advocates the designation "lymphomatoid diseases" in reference to the leukemias, lymphosarcoma, agranulocytosis, erythroblastosis, and other similar conditions.

ETIOLOGY

1 *Tubercle Bacillus*. Most of the early authors were convinced that the tubercle bacillus was responsible for the production

of Hodgkin's disease. In 8 of Sternberg's original 13 cases definite tuberculosis developed. More recent authors deny vigorously the etiologic importance of the tubercle bacillus. They believe it to be a coincident or secondary invader. Its occurrence is quite frequent, some authors placing its incidence as high as 20 per cent (12). It is logical to suppose that old tuberculous lesions may become reactivated or new infections occur due to the weak, cachectic state of patients suffering from Hodgkin's disease.

2 *Diphtheroid bacilli* are also thought by some authors to be factors in the etiology of the disease, Bunting and Yates (13) and de Negri and Mieremet (14) being among the most ardent advocates of this theory. Bunting and Yates named the organism *Bacterium hodgkini* and claimed that extracts injected into animals produced Hodgkin's granuloma. Diphtheroid bacilli, as well as other organisms, are found in lymph nodes due to a variety of conditions. They may be air-borne laboratory contaminants (Wallhauser, 9).

3 *Brucella*. Parsons and Poston (15) and Wise and Poston (16) reported positive cultures for organisms in the *Brucella* group in 14 cases of Hodgkin's disease. Cultures from 67 cases of diseases of the lymph nodes other than Hodgkin's disease yielded negative results except in a single instance. No other investigators have been able to confirm these findings.

4 *Filterable Virus*. Twort (17) presented a theory advocating a filterable virus as the etiologic factor, on the basis of a study of allied disorders, such as leukemia of fowls and pernicious anemia of horses. Gordon (18) injected material from Hodgkin's nodes intracerebrally in animals and produced paralysis and death. He concluded that a filterable virus was the causative agent. Negative results were obtained with extracts from nodes involved by carcinoma, sarcoma, etc.

Turner, Jackson, and Parker (19) demonstrated to their satisfaction that the Gordon test was entirely dependent on the presence of eosinophils and was not spe-

cific for Hodgkin's disease Steiner (20), however, believed the test to be confirmatory if accompanied by histologic examination He admitted that positive results are occasionally obtained from nodes involved by lesions other than Hodgkin's disease but did not agree that eosinophils are the positive factor

5 *Neoplastic Theory* Most modern investigators, including Warthin (21), Mallory (10), and Bell (22), believe Hodgkin's disease to be neoplastic in origin The high fatality rate and the demonstration of cases in which there is a delayed interval between the so-called primary lesions and metastatic lesions are somewhat convincing The absence of any proved infectious agent leads one to believe more strongly in the neoplastic theory

SYMPTOMS AND PHYSICAL FINDINGS

The symptoms of Hodgkin's disease are variable, depending on the stage of progression at the time of the patient's first visit to the doctor The only complaint may be palpable cervical or axillary lymph nodes There may be systemic symptoms of greater or less degree, such as fever, weakness, anorexia, and loss of weight Frequent coincident infections occur, such as tonsillitis, upper respiratory infections, otitis media, and oral infections These may produce adverse effects

Weakness is not infrequently the first symptom and in the absence of obvious lymphadenopathy may be very difficult to evaluate A careful search should be made for enlarged lymph nodes and abdominal masses An x-ray film of the chest may show lesions characteristic of the disease

A dry, hacking cough is often the first indication of involvement of mediastinal nodes Dyspnea, cyanosis, and dysphagia occur later and indicate obstruction due to mediastinal enlargement or to extension of lesions into the lung parenchyma Pulmonary involvement is often accompanied by fever Venous engorgement may also occur and is a very distressing symptom

Nausea and vomiting do not necessarily

suggest occurrence of the disease in the gastro-intestinal tract but can best be explained by the systemic effects Abdominal pain is usually an indication of the presence of enlarged abdominal nodes with pressure effects The hemorrhagic diathesis present in the disease may produce melena and hematemesis

Occasionally, paralysis of one or both lower extremities occurs as a result of vertebral or extradural involvement Collapse of the vertebrae, however, may occur without paralysis Enlarged retroperitoneal nodes are the commonest cause of backache This symptom is a sufficient indication for x-ray therapy to the retroperitoneal region in the presence of Hodgkin's disease, even in the absence of other positive signs

Pain usually occurs in bone lesions before these are actually demonstrable on the x-ray film In 13 cases reported by Jackson and Parker (23), pain was present for two to twelve months before positive roentgenograms were obtained, in spite of repeated examinations Conversely, large bone lesions have been found without symptoms

Pruritus often occurs early in the disease, and its presence is disturbing It can be severe enough to lead to marked excoriations of the skin from scratching Often there is no visible change but on microscopic examination, many of these cases will show some degree of lymphocytic infiltration The more specific lesions have been designated "lymphogranulomatosis cutis" and have a nodular or ulcerated appearance Pruritus is occasionally the first symptom, and any case of idiopathic pruritus should be examined closely for evidence of enlarged lymph nodes

PATHOLOGY

According to Bell (22), the lymph nodes on gross examination are enlarged, pale, and firm, and of fleshy or fibrous consistency They have a definite tendency to remain discrete and seldom become matted together The same appearance is seen on gross examination in aleukemia and lym-

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Males	115 (62%)
Females	70 (38%)
TOTAL	185 (100%)

be of great assistance in determining the site and extent of the lesion. In these cases a tentative diagnosis of lymphoblastoma can be made, with the aid of the history, physical examination, and laboratory studies, but it may be impossible to determine the subdivision. X-ray therapy should be suggested as a therapeutic test to determine response, which occurs quite rapidly in lymphoblastomas.

3. Certain of the clinical findings commonly found in Hodgkin's disease, such as pruritus, Pel-Ebstein fever, and lymph node enlargement, should lead to a strong suspicion of the diagnosis. Eosinophilia is suggestive for differentiation from diseases not having this finding.

DIFFERENTIAL DIAGNOSIS

It is sometimes difficult to differentiate Hodgkin's disease from the other members of the lymphoblastoma group even when a biopsy has been obtained, *viz*, the leuke-

mic feature, the diagnosis may be obscure. Other commonly recognized types of splenomegaly are those of Banti's syndrome, splenic anemia, Gaucher's disease, thrombocytopenic purpura, amyloid disease, syphilis, malaria, the leukemias, etc. In many cases, the diagnosis is obvious from other clinical and laboratory findings, but biopsy is necessary for confirmation.

In cases with bone involvement, the appearance may simulate multiple myeloma. The characteristic Bence-Jones protein, elevated globulin, and diagnostic bone marrow studies are conclusive in myeloma.

INCIDENCE

Race Hodgkin's disease attacks individuals of every race without discrimination. In America, it affects Negroes and whites to about the same extent.

Sex The disease is more prevalent among men than in women. Of Wallhauser's (9) series of 1,447 cases collected from the literature, about 70 per cent occurred in males. In our series of 185 patients with proved Hodgkin's disease (Table I) 62 per cent were men and 38 per cent females.

TABLE II AGE DISTRIBUTION OF HODGKIN'S DISEASE
(185 Cases with Positive Biopsy)

	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Number	6	23	50	29	30	24	16	6	1
Pcr cent of total in each decade	3	12	27	16	16	13	9	3	1
Duration of life in months from first treatment for each decade	37	53	33	45	43	16	19	17	1
Average survival time for 185 cases from first treatment at University of Minnesota Hospitals (25 patients still living)									33 0 months
Average interval from time of onset to first treatment									16 months (171 cases)
Median age									34 years
Average age									38 years

mic and lymphosarcomas. Metastatic carcinoma is often difficult to differentiate from Hodgkin's sarcoma. Tuberculous adenitis also provides considerable trouble because of the necrosis, fibrosis, and the similarity of the constituent cells. Other types of lymphadenopathy accompanying local or generalized inflammatory disease are less confusing clinically and microscopically.

When an enlarged spleen is the outstand-

Age In most series reported, the onset in the greatest number of cases occurred in the third decade of life. In our series, as shown in Table II, the greatest percentage were in the third decade, 27 per cent as compared with 12 per cent in the second decade and 16 per cent in the fourth decade, extremes of age were 5 and 81 years, and the average age was 38 years (The age as given in this series is the age at time of treatment).

phosarcoma On section, areas of caseous necrosis are rather common in the lesions of Hodgkin's disease This finding has been responsible for the suggestion of a tuberculous etiology, but the necrosis is actually due to the disease itself

The microscopic structure is widely variable in different cases and to a lesser extent in various lymph nodes from the same individual Some structural differences occur, also, related to the stage of the disease There are certain features, however, distinctive of Hodgkin's disease, as an increase in the number and size of the reticulum cells, often with the formation of giant cells of Dorothy Reed type, increase of reticulum fibers with the formation of areas of fibrosis, obliteration of the sinusoids, eosinophil cells, areas of necrosis and increase of lymphoid cells

Jackson and Parker (24) would restrict the diagnosis of Hodgkin's disease to cases showing Dorothy Reed cells Bersack (25) states that the Reed cells are present only in the later course of the disease In many of his cases, even after careful examination, Dorothy Reed cells were not found, but specimens from the same patients, after further progression of the disease, showed typical findings

Enlargement of the lymph nodes with obliteration of the sinusoids is of great diagnostic importance The areas of necrosis can be distinguished from tuberculosis by their sharp demarcation from the surrounding tissue and the absence of epithelioid cells Often there are large numbers of eosinophil leukocytes in the cellular areas

The cellular forms of Hodgkin's disease blend with leukemia There is also a blending with lymphosarcoma and leukemic reticuloendotheliosis A single node is often insufficient for differentiation, and difficulties are encountered even at autopsy Occasionally one of the lesions of Hodgkin's disease grows rapidly and exhibits the histologic structure of a sarcoma

Jackson and Parker (24) present a new concept of the disease They describe three types, each of which has a distinct appearance pathologically and a different

prognosis According to these authors, the *paragranuloma* is the early variety, and its main feature is lymphoid hyperplasia, the principal cell being the adult lymphocyte Reed-Sternberg cells are present in small numbers The *paragranuloma* is considered rather benign, but it may progress to the next type, called *Hodgkin's granuloma* In the *granuloma* group, the distinguishing features are eosinophilia, necrosis, and fibrosis This is the group most commonly seen in clinical practice and presents a serious prognosis The third type, *Hodgkin's sarcoma*, is highly malignant The principal features are the presence of large tumor cells and Reed-Sternberg cells with only occasional necrosis and relative rarity of the characteristic cells in granuloma This form is rapidly progressive and fatal in a short time It is most commonly primary in the retroperitoneal lymph nodes and gastrointestinal tract but rather uncommon in the peripheral nodes

Jackson and Parker attach great significance to the histologic appearance as an indication of the prognosis of the disease Among the numerous authors who dispute this are Slaughter and Craver (26), who reported 14 cases of Hodgkin's sarcoma, with 5 patients surviving over three years, 3 of these for more than five years, and one for over seven years—a good survival rate for any group of Hodgkin's disease The patients in their general series who survived less than six months presented no consistent histologic picture

DIAGNOSIS

1 A positive diagnosis of Hodgkin's disease depends entirely on its histologic appearance Any lymph node which is definitely enlarged can be selected for biopsy, but the largest is probably the best choice, since sections can be made from more widely separated areas

2 In a smaller percentage of cases no enlarged lymph node can be palpated and onset may be in the mediastinal nodes or abdominal nodes In the mediastinal cases, examination by means of x-ray will

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SITE OF ONSET

As in other series, most of our cases of Hodgkin's disease seemed to originate in the peripheral lymph nodes (Table III). The disease began in the cervical nodes in 61 per cent of the series, in the axillary nodes in 10 per cent. Some of the more unusual sites of origin were the breast, thyroid, and tonsil, each represented by one case, the bone, 3 cases, the skin 9 cases. The last figure includes those cases in which pruritus was the first symptom noted. Many cases which have their

TABLE III SITE OF INITIAL INVOLVEMENT IN HODGKIN'S DISEASE

(185 Cases with Positive Biopsy)

	Cases
Cervical lymph nodes	112 (61%)
Axillary lymph nodes	19 (10%)
Supraclavicular lymph nodes	4 (2%)
Inguinal lymph nodes	8 (4%)
Mediastinum	11 (6%)
Mediastinum plus pulmonary infiltration	3 (2%)
Abdominal nodes	7 (4%)
Skin	9 (5%)
Bone	3 (2%)
Breast	1 (0.5%)
Generalized	6 (3%)
Thyroid	1 (0.5%)
Tonsil	1 (0.5%)
TOTAL	185 (100%)

origin in deeper areas, such as the abdomen, are not discovered until peripheral node involvement has occurred, and are then mistakenly thought to have begun in these peripheral areas.

SITE OF INVOLVEMENT

Since Hodgkin's disease is histologically a disease of the reticulo-endothelial system, it may be found in almost any organ of the body. The peripheral lymph nodes are the most frequently involved. In our series (Table IV) 98 per cent of the cases showed some type of peripheral lymphadenopathy at some time in the course of the disease. The cervical nodes were involved in 83 per cent of the cases, followed by the axillary nodes in 65 per cent, inguinal in 44 per cent, and supraclavicular in 21 per cent.

In Craver's series (27) of 220 cases, lesions of the lung were present in 29 per cent of the total number. In our series of

TABLE IV SITE OF INVOLVEMENT IN HODGKIN'S DISEASE

(185 Cases with Positive Biopsy)

	Cases	Per Cent
Peripheral lymph nodes	181	98
Cervical	154	83
Axillary	120	65
Supraclavicular	38	21
Inguinal	81	44
Thoracic	123	66
Mediastinal lymph nodes	113	61
Parenchymal involvement	56	30
Pleural effusion	18	10
Abdominal lymph nodes (plus retro-peritoneal)	100	54
Spleen	57	31
Skin	31	17
Bone	37	20
Nervous system	4	2
Muscle	8	4
Liver	19	10
Omentum	1	0.5
Parotid gland	1	0.5
Pancreas	5	3
Stomach	6	3
Adrenals	3	2
Thyroid	3	2
Eustachian tube	1	0.5
Face	6	3
Breast	6	3
Kidneys	6	3
Peritoneum	1	0.5
Gallbladder	1	0.5
Tonsil	1	0.5

185 proved cases, intrathoracic lesions were present in 66 per cent, which appears to be higher than in most comparable groups. Mediastinal lesions were present in 61 per cent of the total number and parenchymal lesions in 30 per cent. In all these cases the involvement was verified either by chest roentgenograms or at autopsy. Pleural effusions were present in 10 per cent of the cases, which is somewhat less than in most other groups. In Wright's series (28) of 60 intrathoracic cases, x-ray examination showed involvement of the mediastinal nodes in 57 patients. Twenty-one patients had parenchymal lesions and there were 17 instances of pleural effusion.

Abdominal manifestations may resemble tuberculous peritonitis, with a serous or, rarely, a chylous ascites. Retroperitoneal involvement may be revealed by the effects of pressure on the vena cava, bowel or nerves. Jaundice may result from pressure on the bile ducts, fluctuating in degree. It is impossible in many cases to distinguish abdominal from retroperitoneal

node involvement, all of our cases, therefore, have been classified as having abdominal node involvement. In most of this group palpable masses were present in the abdomen. In a smaller number, no palpable masses were present but symptoms of abdominal involvement were extremely suggestive in cases where a diagnosis of Hodgkin's disease had already been made from biopsy of a peripheral lymph node. The abdominal and retroperitoneal nodes were involved in 54 per cent of the 185 cases.

The spleen was enlarged in 31 per cent of the 185 cases, and such enlargement was accepted as sufficient evidence of involvement in cases of known Hodgkin's disease. Many authors state that the spleen is involved in 60 to 70 per cent of all cases, usually being diffusely enlarged or containing local foci, which are grossly yellow or gray and suet-like in appearance.

Bone lesions are most often osteolytic and occur in the ribs, sternum, vertebrae, pelvis, humerus, and femur. These lesions are frequently single and appear on the roentgenogram as rarefied cystic areas, sharply demarcated. Occasionally an osteoblastic lesion is present and involves more than one bone. This type responds to treatment less satisfactorily than the osteolytic type. In our series bone lesions, demonstrable by x-ray examination, were present in 20 per cent of the cases. In a series of 257 cases reported by Vieta *et al* (29), bone lesions were present in 15 per cent, 58 per cent of the lesions were of the mixed variety, 28 per cent were entirely osteoclastic, 14 per cent were purely osteoblastic. The bone lesions may develop by enlargement of foci in bone marrow or by extension of adjacent foci infiltrating or pressing on bony structure. All bone lesions in our cases were demonstrable by x-ray examination or at autopsy.

Nerves and spinal cord can be similarly involved by the spreading lesions, producing pictures difficult to differentiate from neoplastic or other disease. Herpes zoster is a fairly common complication of Hodgkin's disease (6 cases in our series). Le-

sions in the nervous system were present in 4, or 2 per cent, of our series.

Pregnancies occurred in 4 cases at some time following treatment. In all, 6 children were born to 4 patients.

Tuberculosis in an active or inactive state was present in 6 cases. Tuberculosis and Hodgkin's disease are not infrequently coincidental, as stated by Sternberg (7).

An unusual site of involvement is the breast, according to Adair and Craver (30). These authors found only 8 cases in the literature and added 5 cases, producing a total of 13. There were 6 examples of breast involvement in our series. In one of the cases a breast lesion developed during the course of the disease, and the breast was amputated. Histologic examination revealed the typical structure of Hodgkin's disease. One male patient, aged 27, had a diffuse infiltration of the entire breast, which responded well to therapy. Two patients had nodules in the breast. Another had a large mass in the breast, and the sixth had a diffuse enlargement of the whole breast. While a positive biopsy of the breast lesion was obtained in only one case, the presence of definite masses or infiltration of the breast and their response to x-ray therapy in cases of known Hodgkin's disease are strong evidence in favor of involvement.

TREATMENT

Irradiation either by x-rays or radium is by far the most effective method in the treatment of Hodgkin's disease. The prognosis for cure is uncertain, however, and the term "survival rate" seems the proper one to use in respect to this disease.

Hodgkin's disease is so varied in its manifestations that it is necessary to treat each case individually. Different parts of the body should be treated in different ways, depending upon the accessibility of the involved nodes. Some modification of the treatment is also required in advanced stages. A few basic principles are followed, however, in all cases.

Usually more than one node in a chain is involved, and the whole group should be

SITE OF ONSET

As in other series, most of our cases of Hodgkin's disease seemed to originate in the peripheral lymph nodes (Table III). The disease began in the cervical nodes in 61 per cent of the series, in the axillary nodes in 10 per cent. Some of the more unusual sites of origin were the breast, thyroid, and tonsil, each represented by one case, the bone, 3 cases, the skin 9 cases. The last figure includes those cases in which pruritus was the first symptom noted. Many cases which have their

TABLE III SITE OF INITIAL INVOLVEMENT IN HODGKIN'S DISEASE
(185 Cases with Positive Biopsy)

	Cases
Cervical lymph nodes	112 (61%)
Axillary lymph nodes	19 (10%)
Supraclavicular lymph nodes	4 (2%)
Inguinal lymph nodes	8 (4%)
Mediastinum	11 (6%)
Mediastinum plus pulmonary infiltration	3 (2%)
Abdominal nodes	7 (4%)
Skin	9 (5%)
Bone	3 (2%)
Breast	1 (0.5%)
Generalized	6 (3%)
Thyroid	1 (0.5%)
Tonsil	1 (0.5%)
TOTAL	185 (100%)

origin in deeper areas, such as the abdomen, are not discovered until peripheral node involvement has occurred, and are then mistakenly thought to have begun in these peripheral areas.

SITE OF INVOLVEMENT

Since Hodgkin's disease is histologically a disease of the reticulo-endothelial system, it may be found in almost any organ of the body. The peripheral lymph nodes are the most frequently involved. In our series (Table IV) 98 per cent of the cases showed some type of peripheral lymphadenopathy at some time in the course of the disease. The cervical nodes were involved in 83 per cent of the cases, followed by the axillary nodes in 65 per cent, inguinal in 44 per cent, and supraclavicular in 21 per cent.

In Craver's series (27) of 220 cases, lesions of the lung were present in 29 per cent of the total number. In our series of

TABLE IV SITE OF INVOLVEMENT IN HODGKIN'S DISEASE

(185 Cases with Positive Biopsy)

	Cases	Per Cent
Peripheral lymph nodes	181	98
Cervical	154	83
Axillary	120	65
Supraclavicular	38	21
Inguinal	81	44
Thoracic	123	66
Mediastinal lymph nodes	113	61
Parenchymal involvement	53	30
Pleural effusion	18	10
Abdominal lymph nodes (plus retroperitoneal)	100	54
Spleen	57	31
Skin	31	17
Bone	37	20
Nervous system	4	2
Muscle	8	4
Liver	19	10
Omentum	1	0.5
Parotid gland	1	0.5
Pancreas	5	3
Stomach	6	3
Adrenals	3	2
Thyroid	3	2
Eustachian tube	1	0.5
Face	6	3
Breast	6	3
Kidneys	6	3
Peritoneum	1	0.5
Gallbladder	1	0.5
Tonsil	1	0.5

185 proved cases, intrathoracic lesions were present in 66 per cent, which appears to be higher than in most comparable groups. Mediastinal lesions were present in 61 per cent of the total number and parenchymal lesions in 30 per cent. In all these cases the involvement was verified either by chest roentgenograms or at autopsy. Pleural effusions were present in 10 per cent of the cases, which is somewhat less than in most other groups. In Wright's series (28) of 60 intrathoracic cases, x-ray examination showed involvement of the mediastinal nodes in 57 patients. Twenty-one patients had parenchymal lesions and there were 17 instances of pleural effusion.

Abdominal manifestations may resemble tuberculous peritonitis, with a serous or, rarely, a chylous ascites. Retroperitoneal involvement may be revealed by the effects of pressure on the vena cava, bowel or nerves. Jaundice may result from pressure on the bile ducts, fluctuating in degree. It is impossible in many cases to distinguish abdominal from retroperitoneal

Al, the half-value layers being 1.4 and 1.7 mm

Total Body Irradiation The principle of small doses of irradiation to the entire body, or spray irradiation, was described by Dessauer (33) in 1907 and by Chaoul and Lange (34) in 1923. The latter workers used it in 12 cases of Hodgkin's disease with varying degrees of success. A similar method was introduced at Memorial Hospital, New York, in 1931 by Heublein (35) and has been called the "Heublein method." Even moderate doses of x-rays to the entire body in man would, of course, produce deleterious effects. In the animal, one erythema dose led to rapid death. Small doses, however, often resulted in considerable reduction in size of the tumor.

Heublein, in collaboration with Craver and Failla of the Memorial Hospital, devised a method of treating patients with prolonged continuous irradiation with hard roentgen rays at low intensity at a distance of 3 meters, and Medinger and Craver (36) report a series of cases treated by this method. Dosage was about 17 r per day, in air, at a rate of 0.86 r per hour, for an average dose of 100 r. No cases of Hodgkin's disease were treated with the Heublein method alone, because it was considered unwise not to give additional local therapy to each group of enlarged nodes. Ninety-four cases were treated with local therapy and total body irradiation, with an average survival period of forty-two months. For all cases, irrespective of the method of treatment, the average was thirty-four months. In the Heublein series, the five-year survival rate was 24 per cent, which was an improvement of 6 per cent over the complete series of Hodgkin's disease treated at that clinic.

As a result of their observations on total irradiation, Medinger and Craver reached the following conclusions:

1 Total body irradiation alone is not sufficient to produce lasting results.

2 The greater the amount of previous roentgen therapy, the poorer the response to total irradiation.

3 Terminal cases of Hodgkin's disease were unaffected by the treatment.

4 The first few treatments were most beneficial.

5 Maximum improvement resulted where local disease was first controlled by local therapy.

Certain reactions to the x-ray body bath may occur, particularly gastro-intestinal disturbances, weakness, apathy, fever, purpura, and unfavorable blood changes. In patients who have recently received large doses of x-ray and have leukopenia, the method should be used with great caution.

Total body irradiation according to the Heublein technic is extremely impractical in most clinics because of the limited number of x-ray machines available. With this procedure, one machine must be devoted daily to the treatment of only two patients for periods of twenty hours or more. Routine use of the method has not been tried at our clinic. Spray irradiation has been given here at a much higher rate per minute, to a total dosage of 30 r at a target-skin distance of 140 cm, two or three doses constituting a series. Two patients showed remarkable improvement following such treatment, and the improvement lasted long enough so that benefit from local therapy was obtained. In most cases, however, where this type of therapy has been given, the patients were in the terminal stages of the disease and were unimproved.

Treatment According to Systems In all locations where it is possible, 900 r, in air, should be given to each of three areas. This is applicable in the cervical region. Where there is bilateral cervical involvement, however, considerable care must be exercised in directing the x-ray beams in order to prevent too much concentration in the central area of the neck. Extreme discomfort can be produced by excessive reaction in the pharynx or esophagus, resulting in dysphagia, hoarseness, and dryness of the throat. This reaction reaches its maximum in approximately three weeks. Rather severe skin reaction can occur from the cross-firing of carelessly directed beams in these cases.

Pulmonary involvement is often accom-

treated as a unit. For example, if cervical nodes are involved on one side, it would seem advisable to include the supraclavicular and submaxillary nodes in a single field. Treatment should also be directed to the mediastinum as a whole, rather than being limited to the area where there is a visible mass.

Enlarged nodes usually begin to respond within a few days after the first treatment and may disappear after a relatively small dose. It is likely, however, that some of the abnormal cellular structure indicating activity still remains in the nodes, and a local recurrence will soon be noticed. Since recurrences seem more radioresistant, it is advisable to give a heavier dosage during the initial series to prevent their development. The series should be given in a relatively short time to produce the maximum effect; fourteen days has been arbitrarily chosen as the upper limit. If the treatment can be given in a shorter time without too much ill effect, the results may be even further improved.

A dose of more than 1,000 tissue roentgens is given in almost all cases, in some cases as much as 2,000 tissue roentgens. More than this amount is rarely used.

In the case of cervical nodes, 900 r, in air, is given to each of three fields, an anterior, posterior, and lateral. In the case of the mediastinum, 1,200 to 1,500 r, in air, to each anterior and posterior field is, in our opinion, within the proper range of dosage.

Very large masses of long standing are usually more resistant to radiation than smaller, more recently enlarged nodes and should be treated more heavily. The recently enlarged nodes should, however, be given a certain minimum dosage even though they may respond and return to normal size before the intended amount is administered.

It is impossible to predict future sites of involvement. Isolated areas may become involved, as the scalp or extremities, while the larger chains of nodes are not affected. For this reason, we believe that prophylactic irradiation is contraindicated.

The most favorable cases are those in

which only one chain of nodes is involved and thorough irradiation is given after a biopsy has been taken. Slaughter and Craver (26) refer to local resection followed by irradiation as a successful method in this type of case. They reported 5 cases treated in this manner with very satisfactory results. The survival period in these cases was five, six, eight, eleven, and eleven years. (Finzi, 31, stated that the longest survivals were in patients with strictly localized disease who were treated with heavy dosage even after regression of the nodes.) These results suggest that Hodgkin's disease may start as a localized process, the arrest of which may delay development of a generalized disease.

It is reasonable to suppose that heavy x-ray dosage would produce as effective a result as surgery in the case of radiosensitive lesions such as the lymphoblastomas. In most cases x-ray therapy should be more effective, since all the nodes in the chain would be included.

O'Brien (32) observed one patient who had been treated by surgical excision of nodes in 1920. Nineteen years later there was a recurrence in the supraclavicular nodes, associated with a mediastinal mass. The mediastinal mass was irradiated and the supraclavicular nodes were removed with good results. Histologic examination revealed Hodgkin's disease.

When several chains of enlarged nodes are present, the chain causing the most symptoms is treated first. Two groups of nodes may be treated simultaneously.

An interesting observation is the marked response, in some cases, of generalized manifestations, particularly pruritus, fever, and weakness, to treatment of the local lesions. The pruritus often clears rapidly, and the patient's general condition is usually much improved as the local areas respond.

For the peripheral lesions in our cases, 200 or 220 kv and 0.5 mm Cu plus 1.0 mm Al filter have been used, the half-value layers being 0.9 and 1.3 mm Cu, respectively. For the deeper lesions the filter was increased to 1.0 mm Cu plus 1.0 mm

Al, the half-value layers being 1.4 and 1.7 mm

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Pulmonary involvement is often accom-

TABLE V SURVIVAL RATE IN HODGKIN'S DISEASE AFTER FIRST TREATMENT
(185 Positive Biopsy Cases)

Year	No of Cases	Years of Survival																Living
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1926	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	3	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	8	4	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1
1930	7	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	16	12	7	6	5	3	3	3	3	3	2	2	2	1	1	1	1	1
1932	18	13	11	6	6	4	3	3	2	2	2	2	1	1	1	1	1	1
1933	15	8	7	7	7	7	5	3	2	2	2	1	1	1	1	1	1	1
1934	14	11	7	5*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1935	14	8	8	6	5	4	2	2	2	2	1	1	1	1	1	1	1	1
1936	5	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
1937	15	9	7	6	6	4	4	4	1	1	1	1	1	1	1	1	1	1
1938	12	10	8	6	4	1	1	1	1	1	1	1	1	1	1	1	1	1
1939	13	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	13	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
1941	10	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
1942	15	7	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Cases	185	185	185	185	170	160	147	134	122	107	102	88	74	59	41	35	18	25
Survival		111	85	67	53	33	21	19	16	12	8	6	4	3	2	1	1	
Per cent		60	46	36	31	21	14	14	13	11	8	6	4	3	2	1	1	

* Lost contact with one case

panied by rather severe dyspnea because of bronchial obstruction due to enlarged mediastinal nodes. In these cases, it is considered unwise to administer the usual 250 to 300 r, in air, to the mediastinum in one treatment, since edema of the bronchi may occur after the first or second treatment, and edema, added to the constriction already present, will result in serious consequences. Hence 50 to 75 r, in air, should be given at the first treatment, the amount being increased gradually with following treatments until the patient can tolerate an average dose. The obstructive lesions usually respond rapidly, with marked relief of dyspnea.

Cases which have received previous roentgen therapy to the mediastinum or lungs may conceivably develop pulmonary fibrosis when given more radiation in the same regions. While this complication is not very common, it should be kept in mind when interpreting follow-up roentgenograms of the chest. The fibrosis may be misinterpreted as a recurrence of Hodgkin infiltration, resulting unjustifiably in further therapy to this region.

Treatment to the abdominal and retroperitoneal lymph nodes results in certain complications which, however, are usually

not too serious to prevent completion of a full series. Nausea, vomiting, diarrhea, and other gastro-intestinal symptoms are quite common, especially when the treated areas are large. If widely separated masses are present, they are best treated separately. As previously stated, back pain in a known case of Hodgkin's disease is a sufficient indication for therapy even in the absence of palpable masses.

RESULTS OF TREATMENT

Earlier reports show that the duration of life following the onset of Hodgkin's disease was very short, although some patients were known to live from five to ten years without therapy. In general, the survival period in children appeared to be considerably shorter than in adults, the average being under twenty months.

Following the advent of x-ray therapy, there was a distinct increase in the survival period, by as much as one or two years. According to Krumbhaar (11), records at the University of Pennsylvania show a five-year survival rate of 15 per cent and a ten-year survival rate of 6 per cent following the method of Pendergrass. In this series, one patient was living after twenty-two years—the longest period of survival

TABLE VI SURVIVAL RATE IN HODGKIN'S DISEASE AFTER FIRST TREATMENT
(53 Clinical Cases)

TABLE VI SURVIVAL RATE IN (53 Clinical Cases)																				
Year	No of Cases	Years of Survival																		Living
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1926	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1927	5	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1928	4	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1929	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1930	7	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1931	4	2*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1932	6	5	4	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1933	3	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1934	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1937	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1938	4	1	1	1	1	1	1*	0	0	0	0	0	0	0	0	0	0	0	0	0
1939	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1942	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cases	53	53	53	53	50	47	47	47	43	39	37	34	32	29	23	19	12	11	7	4
Survival		29	21	16	11	7	5	3	2	2	2	2	2	2	2	2	2	2	2	2
Per cent		55	40	30	22	15	11	6	5	5	5	5	5	5	5	5	5	5	5	5

* Lost contact with one case

In Craver's (26) series of 265 cases, the five-year survival rate was 18 per cent and the ten-year rate 3 per cent. The average survival for all the cases was 33.8 months from the beginning of x-ray therapy. This series evidently includes the 94 cases previously mentioned which were treated by the Heublein total irradiation technic, with an average survival of forty-two months from the institution of therapy and a five-year survival rate of 24 per cent. Without the inclusion of these cases so good a survival rate would obviously not have been obtained. They probably represent the most favorable results recorded anywhere in the literature.

In our series of 185 cases proved by biopsy (Table V), the five-year survival rate was 21 per cent and the ten-year survival rate 8 per cent. The average duration of life from the institution of therapy was 33.1 months, which is slightly less than the average of 33.8 for Craver's entire 265 cases. His cases were all followed for a period of longer than five years, while our series includes some living patients who have been followed for only three years. Our five-year survival rate is a 3 per cent improvement over the Craver series (Table VII).

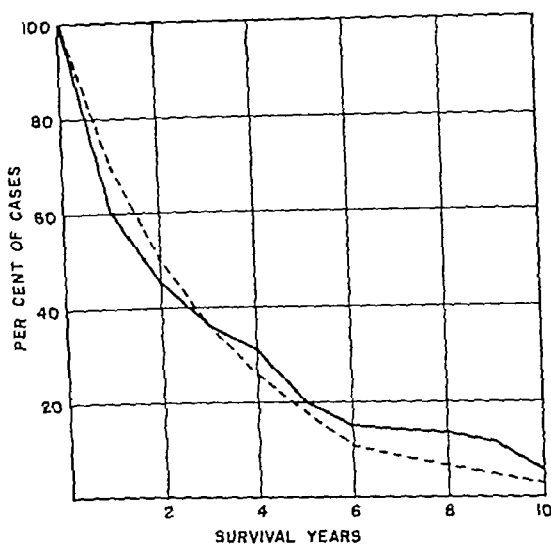


TABLE VII SURVIVALS AFTER TREATMENT IN TWO SERIES OF HODGKIN'S DISEASE. SOLID LINE REPRESENTS UNIVERSITY OF MINNESOTA HOSPITALS SERIES (185 CASES). BROKEN LINE REPRESENTS MEDINGER AND CRAVER'S SERIES (ALL TREATED CASES)

Ewing (37) gave the average survival of untreated patients as about eighteen months. A series of 52 cases of untreated Hodgkin's disease collected by Craft (39) from the autopsy records at the University of Minnesota Hospitals showed a five-year survival rate of 6 per cent from the time of onset. There were no ten-year survivals in this group.

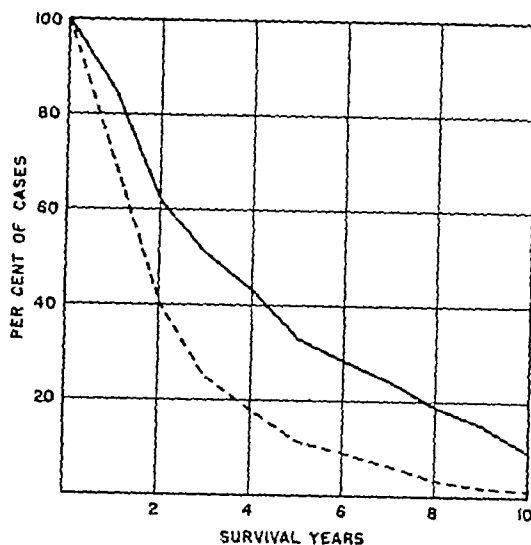


TABLE VIII SURVIVALS AFTER ONSET IN TWO SERIES OF HODGKIN'S DISEASE. SOLID LINE REPRESENTS UNIVERSITY OF MINNESOTA HOSPITALS SERIES (171 CASES). BROKEN LINE REPRESENTS MINOT'S SERIES OF UNTREATED CASES.

It will be noted in Table VI that for 53 cases in which positive biopsies were not obtained at this clinic, the five-year survival rate was only 15 per cent. This is considerably less than the survival rate in the positive biopsy group, which may be largely due to the inclusion of cases which were not truly Hodgkin's disease.

An estimate of the duration from onset of the disease was made in 171 cases in which the time of onset could be determined. The five-year survival rate in this group is approximately three times as great as in a series of untreated cases of lymphoblastoma of all types reported by Minot (38). The interval between the onset and the first treatment in our 171 cases was 15.5 months (Table VIII).

Of 5 patients surviving more than ten years from the beginning of treatment, 4 are still alive, the longest period of survival being sixteen years. Others are living eleven, thirteen, and fourteen years after the first treatment. The patient surviving sixteen years had enlarged nodes in the cervical and axillary regions which were treated in August 1929. There has been no recurrence since that time. The lesions were apparently localized and were adequately treated.

A patient surviving for fourteen years was given radiation to the axilla, abdomen, mediastinum, and spleen over a period of three years, beginning in 1931 at the age of twelve. No recurrences were noted until 1943, when enlarged nodes in the cervical and axillary regions were treated. A mass again developed in the supraclavicular region in July 1945 and was presumed clinically to be recurrent Hodgkin's disease. After removal, however, microscopic examination revealed the characteristic structure of neurofibroma. The patient was living and well in December 1945.

A total of 387 cases of all types of lymphoblastoma (Table IX) had been treated

TABLE IX LYMPHOBLASTOMAS AT THE UNIVERSITY OF MINNESOTA HOSPITALS TO THE END OF 1942

	Dead	Living	Total
Lymphoblastomas (unclassified)	44	16	60
Lymphosarcomas	57	18	75
Aleukemic leukemias	13	1	14
Hodgkin's disease	209	29	238*
TOTAL	323	64	387

* Hodgkin's disease 62 per cent of total

at this clinic up to the end of 1942. Of the total number, 238 or 61.5 per cent were Hodgkin's disease. The percentage of patients with Hodgkin's disease still living is considerably less than for the other lymphoblastomas with the exception of the aleukemic leukemias, the number of which is too small for an accurate estimate of the response.

CASE REPORTS

CASE I S T, female, aged 28, was admitted to the hospital in September 1932 with a history of enlargement of the cervical nodes bilaterally over the previous eighteen months. Dyspnea of mild degree had been present about two months. Biopsy of the cervical nodes revealed the characteristic structure of Hodgkin's disease including Dorothy Reed cells. An x-ray film of the chest demonstrated a mass in the upper mediastinum. The cervical nodes and mediastinum were treated with good response.

In February 1937, a mass developed in the soft tissues over the sternum on the right. The mass was firm and painless and measured $5 \times 6 \times 3$ cm. It responded well to treatment, completely subsiding within two months.

In October 1939, a mass appeared below the left clavicle and an additional small mass in the right hilum. Both lesions were treated with satisfactory results.

In May 1941, inguinal nodes on the right were treated. In August 1941, pain of rather severe degree occurred in the lumbosacral region. X-ray examination revealed partial destruction of the body of the 4th lumbar vertebra. This area was treated with the usual dosage, producing partial relief of pain. In the meantime, a large hard mass developed in the left mid abdomen, probably representing enlarged retroperitoneal nodes. After therapy to this region, the mass entirely disappeared. The patient's health was quite good from November 1941 until August 1942, when mild pain occurred in the left flank. The pain continued until a visit to the clinic in March 1943. A film of the lumbar spine showed partial destruction of the body of the first lumbar vertebra and 12th rib on the left. Treatment to this area gave considerable relief of pain.

Re-examination of the chest in May 1944 revealed an infiltrative lesion in the right base. Intensive therapy was given to this region with good results.

In March 1945, on readmission, severe back pain in the upper lumbar region with radiation of pain anteriorly was described. X-ray examination revealed further destruction of the 12th rib on the left and the 1st lumbar vertebra, and an osteoblastic lesion in the body of the 1st lumbar vertebra, not previously present. On the sixth day after therapy, the patient said she had complete relief of pain. She has remained well since that time. It is now over thirteen years since the first treatment was given and multiple areas have been treated.

CASE II V N, a 59-year old man, was admitted to the clinic in 1926, with a mass of enlarged nodes in the right cervical region. A biopsy specimen was diagnosed by Dr. Bell as a cellular type of Hodgkin's disease. The patient responded well to x-ray therapy but had a single recurrence in the same region several months later which responded less rapidly. Death from pulmonary tuberculosis occurred in 1942. Because of the possibility that the original lesion was tuberculous in origin, this case was not included in the series of 185 proved cases.

SUMMARY AND CONCLUSIONS

A series of 185 cases of Hodgkin's disease proved by biopsy has been reviewed in detail. Statistical evidence has been presented to indicate the multiple areas involved by Hodgkin's disease throughout the body. The peripheral lymph nodes are most frequently affected, followed by mediastinal nodes, abdominal nodes, spleen, and bones. The disease is most

common in the third decade, and about two-thirds of the patients are males.

A method of irradiation therapy has been developed at this clinic, which we believe is very efficient in the treatment of the lymphoblastomas. Treatment is considerably more intensive than in most series reported. A full course of therapy is applied to each area of involvement, the dosage varying between 1,000 and 2,000 tissue roentgens over a period of fourteen days. Large masses are treated more intensively, and the group of enlarged nodes causing the greatest distress is treated first. Prophylactic irradiation, in our opinion, is contraindicated.

The five-year survival rate from the time of treatment in our cases was 21 per cent and the ten-year rate 8 per cent, a high figure as compared with other series. Other statistics have also been presented, demonstrating the marked increase in the survival period from the onset of symptoms in treated cases as compared with a series of untreated cases of lymphoblastoma reported by Minot in 1926.

The unpredictable nature of Hodgkin's disease is recognized and claims of cure cannot be made. Roentgen therapy has, however, markedly increased the survival rate.

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The Early Effects of X-Rays on the Ovaries of the Rat¹

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IRRADIATION of the ovaries with a sufficient dose of x-rays leads, after a certain time, to degenerative changes in these organs (1, 5, 6). Halberstaedter (2), in 1905, found in rabbit ovaries, ten to fifteen days after irradiation, disappearance of graafian follicles and degeneration of primary follicles, the numerous interstitial cells of the rabbit ovary being relatively resistant to x-ray irradiation.

As regards alterations in the ovary in the first few hours following irradiation, a diversity of opinions exists. Reifferscheid (7) described alterations in the ovary of the mouse as early as three hours after irradiation. According to him, numerous pyknotoses are visible at this time in the cells of the granular layer in the large follicles, which later degenerate and undergo lysis within the follicular cavity, at the same time, the nucleus of the ovule loses its normal configuration. Muller (4), however, has argued that the alterations observed by Reifferscheid cannot be ascribed to the action of x-rays, since similar observations have been made in ovaries of non-irradiated mice and guinea-pigs. On the other hand, certain authors have confirmed the findings of Reifferscheid twenty-four hours after irradiation (3). On the whole, the evidence concerning the early effects of irradiation on the ovary has been based on quantitative rather than qualitative changes. In fact, Reifferscheid (9) himself has recognized that the alterations described following irradiation may also be observed in normal ovaries, but in far less degree.

In view of the existing diversity of opinion concerning early lesions of the irradiated ovary, we have carried out histologic examinations of ovaries of normal and irradiated rats with a view to ascertaining

whether there is any difference in the distribution of the pyknotoses in the follicles.

METHOD AND TECHNIC

The histologic studies were performed on ovaries of the following groups of highly inbred albino rats:

- A Control group 4 rats
- B Experimental groups Rats irradiated with 50 to 2,000 r
 - (a) Seven rats, irradiated in the region of the abdomen, the ovaries being exposed directly to the action of the x-rays
 - (b) Two rats, irradiated in the region of the cephalothorax, the ovaries being protected from direct exposure by means of a lead plate
 - (c) Two young rats, irradiated totally

The radiation was delivered from a Machlett therapy x-ray tube, operated on a multivolt apparatus at 150 kv, 4 ma, Al 0.5 mm, distance 30 cm, 100 r/min.

The animals were killed four hours after irradiation. Ovaries were fixed in Bouin's fluid and sectioned after embedding in paraffin. The sections were mounted on slides in complete series and stained with iron hematoxylin (according to the method of Masson) and eosin.

Microscopic preparations were examined in series so as to obtain a complete picture of each follicle, including the ovule and its nucleus.

DESCRIPTION OF MICROSCOPIC PREPARATIONS

In the examination of the microscopic preparations our attention was especially directed to follicular cells of primary follicles and the granular layer of large follicles. At the same time an attempt was made to elucidate the relationship between

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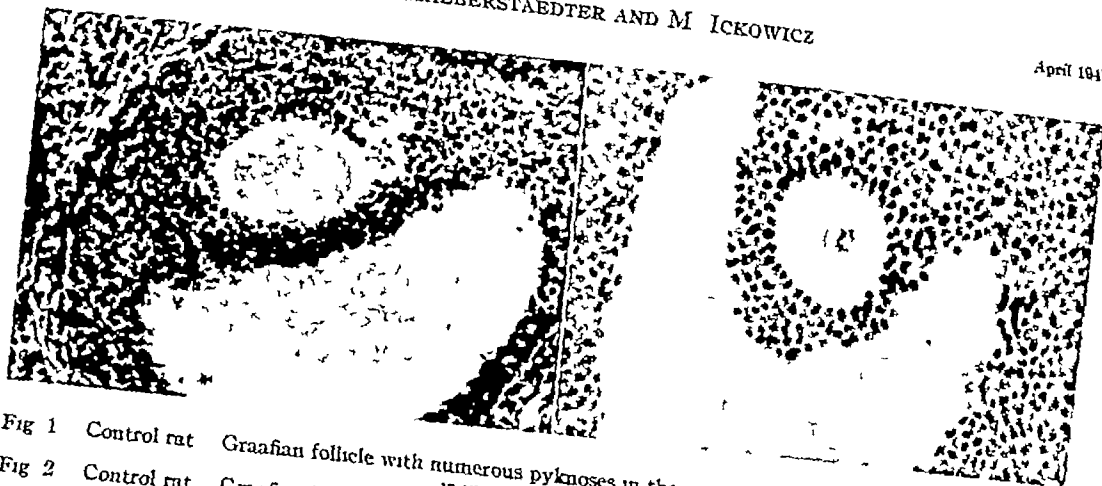


Fig 1 Control rat Graafian follicle with numerous pyknotoses in the granular layer The nucleus of the ovum is in mitosis $\times 225$

Fig 2 Control rat Graafian follicle with the ovule in a resting state. There is almost total lack of pyknosis in the granular layer $\times 225$



Fig 3 Control rat Atresic follicle with degenerate cells representing the residue of the ovule $\times 190$

the state of the nucleus of the ovule and the condition of the follicular cells

A Control Rats Our description of normal ovaries represents the total findings in four controls (a) one rat weighing about 150 gm, (b) two rats weighing about 100 gm, and (c) one small rat weighing 60 gm. Only the more striking features and those which furnish a suitable basis for the evaluation of the effect of radiation will receive emphasis in the following description.

The ovaries contained numerous follicles in varying degrees of development. One finds in a normal ovary follicles of different size, viz, primary follicles, stratified fol-

licles, as well as graafian follicles. In addition, there are atresic follicles well on the way to disappearance. The primary follicles generally contain an ovule whose nucleus is in the germinative vesicle state, with a nucleolus. The layer of follicular cells frequently shows mitotic figures and rarely a pyknotic nucleus. Stratified follicles similarly contain an ovule with a resting nucleus and have a granular layer which exhibits numerous mitoses and some pyknotic cells. Among the large graafian follicles, two types can be distinguished on the basis of the presence of pyknosis in the granular layer. In one pyknotoses are numerous, whereas in the other only a few are visible. This difference is brought out especially clearly when the entire series of sections of an ovary is examined. In one ovary we found a marked pyknosis of the granular layer in nearly one-half of the graafian follicles and a very slight one in the remaining half. When the total number of graafian follicles in an ovary is examined in series it becomes apparent that the pyknotic follicles contain dividing ovules and nuclei in different stages of mitosis (Fig 1). On the other hand, graafian follicles with slight pyknosis contain resting nuclei (Fig 2). The more advanced state of division of the ovule, the greater is the number of the pyknotic follicular cells. In the atresic follicles, the granular layer is almost completely gone, but residues of

the pyknotic debris can be seen. In the contracted cavity of the atresic follicles two or more large degenerate cells representing the residue of an ovule which probably underwent an abnormal series of divisions may be seen (Fig 3)

B Irradiated Rats, Group a Adult rats weighing 150 gm were irradiated in the region of the abdomen. One animal received 50 r, another 200 r, another 400 r, and four 2,000 r each. The histologic findings four hours after irradiation in the rats which received 50 and 200 r were identical with the findings in the non-irradiated controls. The following description summa-

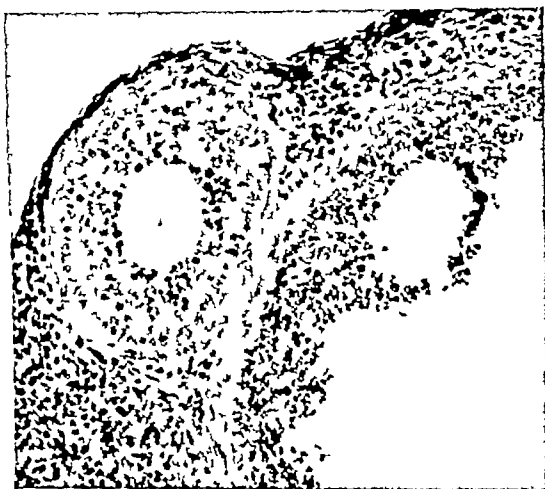


Fig 4 Rat irradiated with 2 000 r. Young follicle and a graafian follicle exhibiting pyknoses of the follicular cells. $\times 190$

izes the observations on the ovaries of the animals irradiated with 400 r and 2,000 r, respectively.

Rat 3, of medium weight (150 gm), was irradiated in the region of the abdomen with 400 r. The cephalothoracic region was protected from direct exposure by means of a lead plate. The animal was sacrificed four hours after the irradiation. The histologic examination revealed a cellular lesion which was manifested as a pyknotic reaction in the follicular cells of the follicles. Pyknoses were evident in primary follicles which did not show alterations of the ovule. In the most developed follicles, *i.e.*, the stratified follicles, a number of

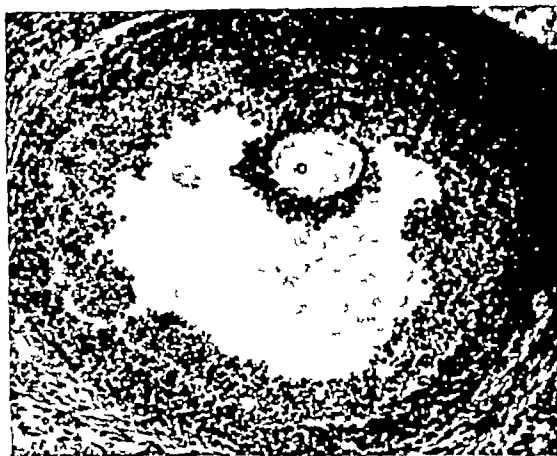


Fig 5 Rat irradiated with 2,000 r. Graafian follicle with numerous pyknoses in the granular layer. The nucleus of the ovum is in a resting state. $\times 125$

pyknoses were also exhibited. The ovules of these follicles had a practically normal appearance. The graafian follicles in most cases presented numerous pyknoses. These were especially numerous and were found constantly in follicles which contained a mitotic ovule. When the ovule was in a resting state, on the other hand, the pyknoses were not always equally numerous. Only a certain number of these follicles showed numerous pyknoses. Follicles could also be observed in a state of degeneration, with large cells representing the residue of an abnormally divided ovule.

Rat 18, of medium weight (150 gm), received 2,000 r in the region of the abdomen, the cephalothoracic region being protected by means of a lead plate. The animal was killed four hours after irradiation. The ovary contained numerous follicles in different stages of development. The pyknotic lesions in the follicles were very pronounced. Some young follicles and those in an advanced stage of development exhibited numerous pyknoses in the granular layer (Fig 4). Pyknoses were found in all follicles, irrespective of the state of development of the contained ovule. Follicles with a dividing ovule and with a resting ovule (Fig 5) were affected to an almost equal degree. Some of the follicles undergoing atresia exhibited the usual picture of an abnormal dividing



Fig 6 Rat irradiated with 300 r. Atresic follicle with an ovule containing a dividing nucleus with a globular polar body. $\times 225$

ovule. In the corpora lutea no demonstrable lesion was found.

Rats 26, 27, and 28, which received the same dosage of x-rays and were killed after four hours, showed the same microscopic picture as rat 18.

Irradiated Rats, Group b This group consisted of 2 rats, irradiated in the region of the cephalothorax.

Rat 10, of medium weight (150 gm), received 400 r in the region of the cephalothorax. The abdominal region, in which the ovaries lie, was protected from direct exposure by means of a lead plate. The animal was killed after four hours. On microscopic examination, the ovary was seen to contain follicles in different stages of development. There were numerous corpora lutea. The young follicles showed no alterations which could be ascribed to the effect of x-rays. The developed follicles presented two aspects: (a) follicles with pyknotic cells and ovules in a state of division and (b) cells of the granular layer with few pyknoses and containing a resting ovule. In general, the picture is one which can be observed in a non-irradiated ovary.

The ovary of a second rat irradiated in the same manner showed the same microscopic picture.

Irradiated Rats, Group c Two young rats were irradiated totally with 50 and 300 r, respectively. The animals were sacrificed four hours after irradiation.

Rat 4, weighing only 60 gm, received a total dose of 50 r. Histologic examination revealed no lesion which could be attributed to the action of x-rays. The young follicles showed no alteration, while in the graafian follicles the alterations were of a type observed in graafian follicles of non-irradiated ovaries, namely a few pyknoses in follicles containing a resting ovule and numerous pyknoses in the granular layer of follicles with a dividing nucleus.

Rat 5, also weighing about 60 gm, received a total x-ray dose of 300 r. The histologic examination disclosed pyknotic lesions in most of the follicles. One or two of the large follicles were free from pyknotic lesions. In the majority of cases the granular layer of the follicles exhibited a marked pyknotic reaction independently of whether the contained ovule was in a state of division or rest. A large number of atresic follicles, some with ovules containing a dividing nucleus with globular polar bodies (Fig 6) and some with large cells in a state of degeneration, were evident.

DISCUSSION

Our histologic examinations show that follicles with signs of degeneration are normally present in the ovary of the rat. The degenerative process begins with appearance of numerous pyknoses in the cells of the granular layer of the follicle, which undergoes lysis within the follicular cavity. Following the pyknotic destruction, the granular layer becomes thinner and finally disappears, leaving debris of pyknotic nuclei. The appearance of numerous pyknoses coincides in time with the presence of mitotic figures in the ovule. The degree of the pyknotic degeneration of the granular layer is the greater the more advanced is the state of division of the ovule.

These degenerative changes in the ovary resemble those observed by Reifferscheid a few hours after irradiation. It is entirely comprehensible, therefore, that Müller should have doubted their relation to irradiation. However, it seems to have escaped both authors that in non-irradiated ovaries pyknoses are largely restricted to

follicles whose ovules are in a state of division. When the follicles are examined in entirety, it becomes evident that pyknotoses are normally very rare in the granular layer of follicles whose ovule contains a nucleus in a resting state (Fig 2) and that they are numerous in follicles whose ovule contains a nucleus in a state of division (Fig 1). The evaluation of the effect of x-rays on the ovary is best made, therefore, on the basis of findings in follicles which contain an ovule with a resting nucleus.

Our observations have shown that four hours following irradiation numerous pyknotoses are evident in the granular layer of the large follicles irrespective of whether the nucleus of the ovule is in a state of division or rest (Fig 5). Pyknotoses were found, moreover, in follicular cells of young follicles in rats which had been irradiated (Fig 4), but never in corresponding follicles of non-irradiated rats. The impression was further obtained that follicles whose ovule is in a state of division show pyknotoses in cells of the granular layer more frequently after irradiation than normally. This impression by itself would lack conviction were it not accompanied by the further observation that pyknotoses occur following irradiation in follicles whose ovules are in a state of rest. The general conclusion may be drawn that a sufficient dose of x-rays produces lesion of the ovaries of a rat as early as four hours after irradiation.

The results were best defined with doses of 2,000 r delivered in the abdominal region. A pronounced pyknotic lesion was also observed in the rat which received 400 r (rat 3) in the abdominal region. On the other hand, the rats given 400 r in the cephalothoracic region did not exhibit

similar pyknotic lesions. It is our impression, therefore, that the reaction of the ovary is not the same when it is not directly exposed to the x-rays.

No demonstrable difference was found between ovaries irradiated with doses of 50 and 100 r and non-irradiated ovaries. Doses of this magnitude are probably too low to evoke pyknotic lesions in the ovary within an interval of four hours.

SUMMARY

In ovaries of normal rats, pyknosis in the granular layer is generally restricted to follicles whose ovule contains a nucleus in a state of division. Four hours after irradiation with a sufficient dose of x-rays, pyknotoses are also in evidence in follicles whose ovule contains a resting nucleus, as well as in primary follicles.

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A Roentgenkymographic Study of the Heart in Myasthenia Gravis¹

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THE ROENTGENKYMOGRAPH has been established as a helpful adjunct in the study of certain diseases of the heart. It is generally recognized that the main value of this instrument is its ability to record permanently the motion of an organ observed fluoroscopically.

In 1939, changes in the cardiac motion of a patient with myasthenia gravis were detected by the author fluoroscopically while examining the effects of prostigmine on the hypopharynx (4). Inasmuch as all previous cardiac studies in myasthenia gravis had been reported negative (8), the observation was considered preliminary until the kymograph, by recording the pulsations objectively, appeared to confirm the finding. Similar observations were then made on several other patients with myasthenia gravis. The kymograms showed a slight slowing of the pulse, with minor but definite changes in the waves along the left ventricular border after a test dose of prostigmine. In normal young adults used as controls, kymographic changes similar to those found in myasthenia gravis patients could be obtained by the same technique. This indicated that we were dealing with a pharmacologic action of prostigmine and not a sign characteristic of a specific disease entity.

Further studies then were carried out. An effort was made to detect minor differences in the kymographic wave forms of normal subjects as compared with myasthenia gravis patients, and an explanation was sought for the kymographic changes observed following a test dose of prostigmine² when other cardiac studies were negative in the same patients.

The work was stimulated by a personal

communication from Dr. Sidney Lange of Cincinnati, who had previously made a single cardiac roentgenkymogram on one of his patients with myasthenia gravis. Although the kymogram showed changes which he was unable to explain, he did not consider the single observation of sufficient importance to justify publication. To our knowledge, Dr. Lange is the only previous worker to use the roentgenkymograph in the study of this disease.

The purpose of this paper is to record our findings and to call attention to certain variables which limit the use of the kymograph in studies of this type.

METHOD

Four normal persons and 16 patients with myasthenia gravis were examined. The patients with myasthenia gravis had been extensively studied at the Myasthenia Gravis Clinic of the Massachusetts General Hospital and represented typical cases of the disease.

If the patient had been receiving prostigmine, this drug was withdrawn for twelve or more hours before the examination. During this period symptoms of lassitude, general muscle weakness, ptosis, dysphagia, dysarthria, and other signs of myasthenia gravis usually developed. A roentgenkymogram of the heart was then made. If the initial film was satisfactory, 15 to 20 mg. of prostigmine methylsulfate with 0.6 mg. of atropine sulfate was given intramuscularly (5). Fifteen minutes later a second roentgenkymogram was obtained.

A roentgenkymograph of the fixed grid type was employed. The average exposure time was one and a half seconds, but this figure was reduced for patients with tachy-

¹ From the Myasthenia Gravis Clinic, Massachusetts General Hospital. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

² The prostigmine was furnished by Hoffman-La Roche, Inc.

cardia and increased for patients with bradycardia. The exposure time in any individual case, however, was not varied. A rotating-target x-ray tube, operating at 150 ma and 55-70 kv, was so placed as to provide a 28-inch target-film distance. Par-speed intensifying screens were used. An immobilizing band was found particularly useful in patients with pronounced muscle weakness. Exposures were made with the patient standing in the upright position facing the film and holding his breath in full inspiration. Care was taken to duplicate the radiographic technic as accurately as possible before and after the prostigmine was given.

In order to obtain strictly comparable films, to evaluate artefacts due to cardiac rotation, several exposures were necessary in some patients, especially those having severe symptoms. Only one patient was excluded from the series. In this case, the kymograms made with the patient horizontal, because of extreme weakness, were useless for comparison on account of artefacts in the kymographic waves due to a high diaphragm and cardiac rotation. As the study progressed, it was noted that relatively minor changes in exposure technic, positioning of the patient, and the height of the diaphragm tend to impose greater difficulties in chest kymography than in routine chest roentgenography. Short tube-film distances distort and magnify not only the individual kymographic waves but also the aberrations in the waves due to the above factors. Although teleroentgenkymography has been successfully used by Ungerleider and Gubner (9) to eradicate the difficulties imposed by a short tube-film distance, most x-ray departments do not possess a tube capable of tolerating the high energy necessary for such a procedure.

In order to identify possible sources of error due to the above factors, each pair of kymograms in this study was analyzed according to a predetermined routine. The details on each film were recorded on a large chart in ruled columns which included the following headings: (1) case number, (2) rotation of patient, (3)

height of diaphragm, (4) transverse cardiac diameter in systole and diastole, (5) wave amplitude in millimeters on corresponding points along the aortic, right auricular, and ventricular borders, (6) wave forms in the same areas. Having recorded these observations for each case, the data were reorganized in charts to determine the frequency of occurrence of the various findings, the variations between the individual cases, and the coincidence of common findings in the various columns. Although the number of cases examined was small, the data were considered sufficient to demonstrate or to rule out the presence of any characteristic kymographic sign of myasthenia gravis.

RESULTS

Cardiac and Thoracic Measurements

In a previous study (8) it was found that orthodiagrams of the heart show no significant changes in patients with myasthenia gravis.

In this study the transverse diameters of the heart in both the systolic and diastolic phases were made routinely. When the cases showing any degree of rotation or change in diaphragm were excluded, no constant changes in the diameter of the heart or in wave amplitude in any portion of the heart were observed following the administration of the prostigmine test dose.

An attempt was made to estimate and compare the areas of the heart in systole and diastole by tracing the cardiac contours through the peaks and troughs of the waves as suggested by Stumpf (6) and others (2, 3). This method was found unreliable because of the difficulty in outlining the caudal and cephalic borders of the heart. Other workers (1, 7) have encountered the same difficulty especially when the kymograms are made with a short tube-film distance.

The patients with myasthenia gravis frequently showed a slightly increased chest diameter or a slightly lower diaphragm at deep inspiration after a prostigmine injection. This observation was con-

A Roentgenkymographic Study of the Heart in Myasthenia Gravis¹

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THE ROENTGENKYMOGRAPH has been established as a helpful adjunct in the study of certain diseases of the heart. It is generally recognized that the main value of this instrument is its ability to record permanently the motion of an organ observed fluoroscopically.

In 1939, changes in the cardiac motion of a patient with myasthenia gravis were detected by the author fluoroscopically while examining the effects of prostigmine on the hypopharynx (4). Inasmuch as all previous cardiac studies in myasthenia gravis had been reported negative (8), the observation was considered preliminary until the kymograph, by recording the pulsations objectively, appeared to confirm the finding. Similar observations were then made on several other patients with myasthenia gravis. The kymograms showed a slight slowing of the pulse, with minor but definite changes in the waves along the left ventricular border after a test dose of prostigmine. In normal young adults used as controls, kymographic changes similar to those found in myasthenia gravis patients could be obtained by the same technic. This indicated that we were dealing with a pharmacologic action of prostigmine and not a sign characteristic of a specific disease entity.

Further studies then were carried out. An effort was made to detect minor differences in the kymographic wave forms of normal subjects as compared with myasthenia gravis patients, and an explanation was sought for the kymographic changes observed following a test dose of prostigmine² when other cardiac studies were negative in the same patients.

The work was stimulated by a personal

communication from Dr. Sidney Lange of Cincinnati, who had previously made a single cardiac roentgenkymogram on one of his patients with myasthenia gravis. Although the kymogram showed changes which he was unable to explain, he did not consider the single observation of sufficient importance to justify publication. To our knowledge, Dr. Lange is the only previous worker to use the roentgenkymograph in the study of this disease.

The purpose of this paper is to record our findings and to call attention to certain variables which limit the use of the kymograph in studies of this type.

METHOD

Four normal persons and 16 patients with myasthenia gravis were examined. The patients with myasthenia gravis had been extensively studied at the Myasthenia Gravis Clinic of the Massachusetts General Hospital and represented typical cases of the disease.

If the patient had been receiving prostigmine, this drug was withdrawn for twelve or more hours before the examination. During this period symptoms of lassitude, general muscle weakness, ptosis, dysphagia, dysarthria, and other signs of myasthenia gravis usually developed. A roentgenkymogram of the heart was then made. If the initial film was satisfactory, 1.5 to 2.0 mg. of prostigmine methylsulfate with 0.6 mg. of atropine sulfate was given intramuscularly (5). Fifteen minutes later a second roentgenkymogram was obtained.

A roentgenkymograph of the fixed grid type was employed. The average exposure time was one and a half seconds, but this figure was reduced for patients with tachy-

¹ From the Myasthenia Gravis Clinic, Massachusetts General Hospital. Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9-10, 1945.

² The prostigmine was furnished by Hoffman-LaRoche, Inc.

firmed teleroentgenographically and is consistent with the general picture of myasthenia gravis

Heart Rate Quantitative determinations of the heart rate are not usually made with the roentgenkymograph because of the practical and technical limitations of the method. Stethoscopic or sphygmometric methods are obviously to be preferred. Two or more kymograms made with identical grid speeds, however, are sensitive qualitative indicators of a slight change in heart rate. A slowing of the rate is indicated by a reduction in the number of waves per frame or by the amputation of part of a kymographic wave (Fig 1), whereas an accelerated heart rate is indicated by a relative increase in the number of waves per frame.

Of the 15 patients with myasthenia gravis, 10 showed a slight decrease in heart rate after the injection of prostigmine. The normal subjects showed a similar decrease after the same medication. It is significant, as will be discussed later, that the 4 cases showing no change in rate also showed no changes, or relatively minimal changes, in wave form.

The slight retardation of the heart rate by prostigmine is one of the pharmacologic actions of this drug. The prostigmine test dose as used in this study has been thoroughly investigated. A small amount of atropine was included routinely to counteract the disagreeable side effects of prostigmine, such as abdominal cramps, diarrhea, diaphoresis, etc. Large amounts of atropine usually quicken the rate. It is felt that the amount of atropine used in our test doses was not sufficient to neutralize completely the bradycardiac action of prostigmine.

Wave Form Changes The normal kymographic wave forms in various portions of the cardiac contour have been described many times. The pathologic changes in these waves due to aortic insufficiency, pericardial adhesions, cardiac infarction, and other conditions are also well established. The minor changes, however, within the normal variations of the kymo-

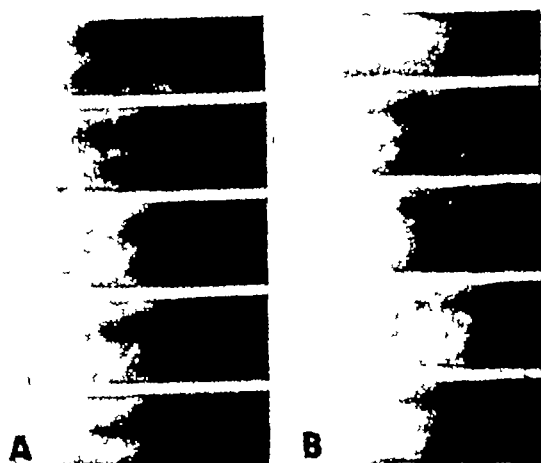
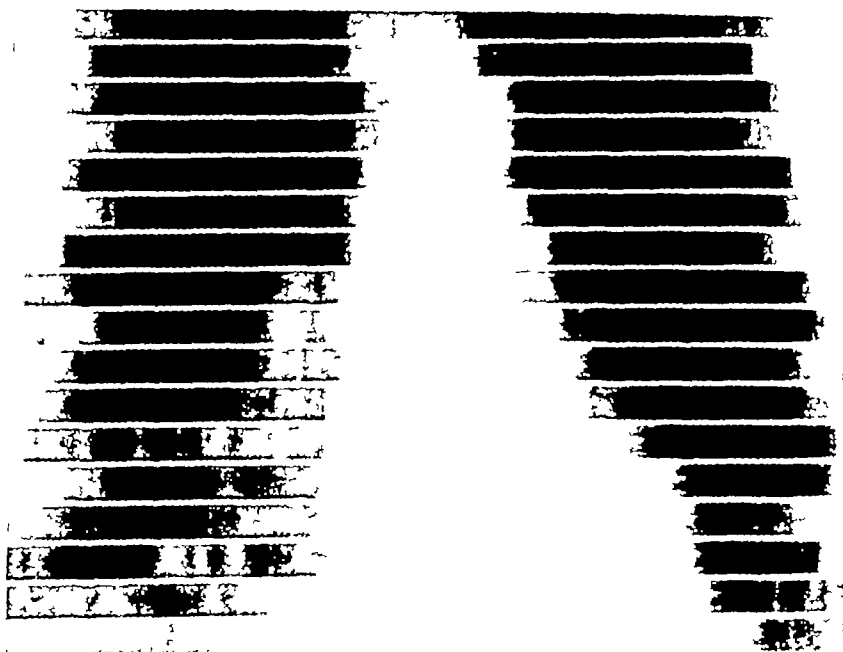


Fig 2 Left ventricular wave changes in another patient (A) before prostigmine and (B) after prostigmine. These changes resemble those seen in Figure 1. Similar but less marked changes were observed in five other patients and also in the normal individuals studied.

graphic wave form have been the subject of much speculation and misunderstanding. Many writers have attempted to associate these changes with abnormal physiologic processes. It is the author's opinion that such minor changes must be subjected to unusually careful scrutiny and care in interpretation. The changes observed in myasthenia gravis fall into this category.

The cases in this series showed no remarkable changes in the waves of the aortic and auricular areas except for slight slowing of the rate. Very definite changes, however, were observed in the ventricular waves. Figure 1A is the roentgenkymogram of a patient with myasthenia gravis, while Figure 1B shows the same patient after the administration of a prostigmine test dose. In Figure 2 the left ventricular waves of another patient with myasthenia gravis have been enlarged and illustrate the changes more clearly. One notices, first, that the prostigmine slowed the cardiac rate, second, the peaks lost their spike-like configuration, third, the diastolic limbs became smoother and more convex. Changes of this type were observed in 7 of the 15 cases studied.

That these changes are not constant is shown by Figure 3, which illustrates some of the variations in the left ventricular wave which were encountered. In Case 60



A



B

Fig 1 A Cardiac roentgenkymogram of patient with myasthenia gravis Note spike-like configuration of waves along left ventricular border
 B Same patient after prostigmine test dose The heart rate has become slower The spiking of the left ventricular waves has disappeared The diastolic limbs are smoother and have changed from concave to convex

who showed no change in heart rate after prostigmine also showed no significant changes in wave form (Fig 4). It is well known that any change in the ratio between the grid speed and the heart rate will affect the appearance of a kymographic wave. If the wave changes in our cases could be explained simply by a change in the grid speed-heart rate ratio, then it would follow that no change in wave form should occur in these individual hearts if the grid speed were so adjusted as to maintain a constant ratio with the heart rate

kymographic wave produced by prostigmine represent artefacts due to the changing ratio between the grid speed and the heart rate

Precise comparative analyses of the wave forms in 5 A and 5 C, however, still reveal some minute differences. These minute differences varied widely from case to case. It would be illogical to attribute such a wide variety of wave form changes to the action of prostigmine or to any particular physiologic theory. It is more reasonable to attribute such a variety of

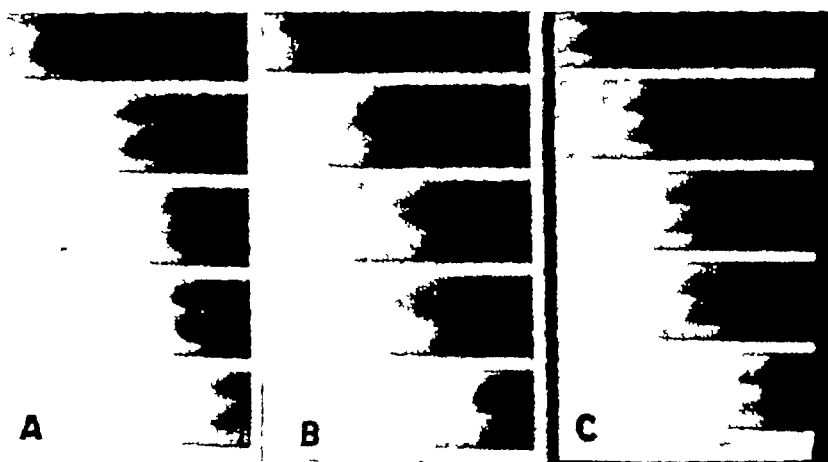


Fig 5 The reason for the apparent changes in wave form in Figures 1 and 2 is explained here. A and B are enlargements of the left ventricular waves in the case illustrated in Figure 1. C was made a few seconds after B but the grid speed was decreased in proportion to the degree of cardiac slowing. Note that the waves in C have practically reassumed their original configuration.

before and after administration of prostigmine.

To test the validity of this assumption, 2 myasthenia gravis patients and one normal person were studied before and after prostigmine with various grid speeds. The results in all 3 cases were remarkably identical. In Figure 5 A and B, the left ventricular waves seen in Figure 1 A and B, respectively, are reproduced. The kymogram 5 C was made a few seconds after 5 B, under identical conditions except that the grid speed was reduced in rough proportion to the degree of slowing of the heart which had occurred. The wave forms in 5 C are almost identical with those in 5 A. This indicates, therefore, that the major changes in the shape of the

minor changes in wave form to the uncontrollable variables and limitations of the technic itself.

Limitations of the roentgenkymographic method are particularly noticeable when the auricular and aortic areas are examined. The waves in these areas are extremely variable, deceptive, and frequently difficult to interpret. In the average kymogram these particular waves often do not exceed 10 mm in amplitude, rarely more than 30 mm. The superimposed vertebrae and mediastinal structures frequently obscure wave detail. Motion in any portion of the cardiac border is the result of several directional forces and does not represent the true intrinsic pulsation of one chamber. Auricular waves frequently ap-

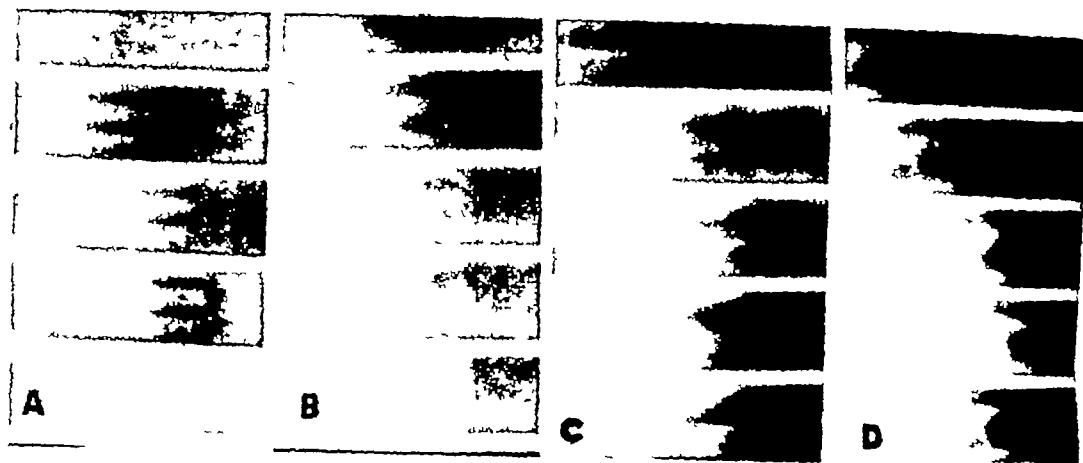


Fig 3 Other types of left ventricular wave changes observed For description, see text

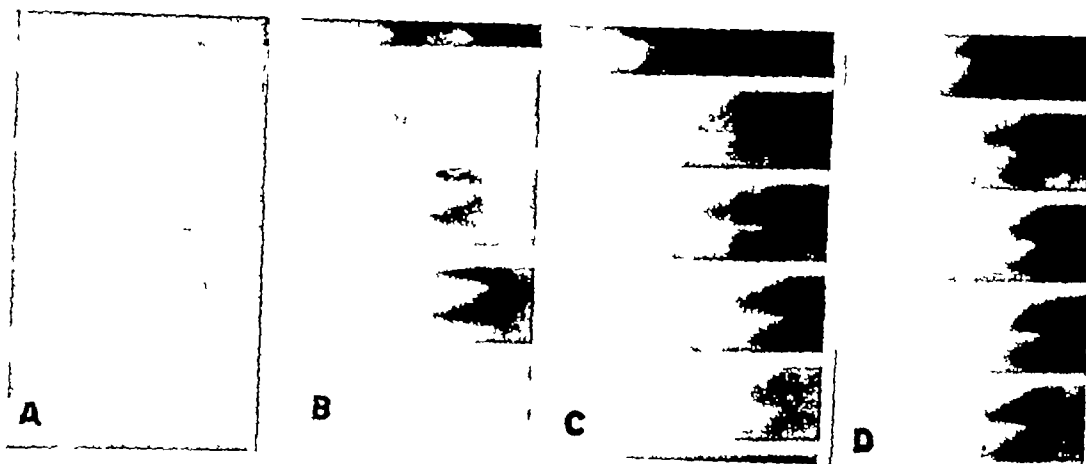


Fig 4 Left ventricular waves in a patient showing no change in heart rate and no significant changes in wave form after prostigmine test dose

(Fig 3 A and B), the prostigmine slowed the rate, the deep biconvex waves along the left ventricular border became shallower, the systolic limbs became flatter and slightly concave, and the diastolic limbs in the lower frames showed a small convex notch. In Case 51 (Fig 3 C and D), the heart rate was slowed, and the concave contour of the diastolic limb became concavo-convex. Other cases not illustrated here showed varying combinations of the minor wave changes described above.

DISCUSSION

Experienced kymographers will recognize that Figures 1, 2, and 3 show wave forms which are frequently encountered in

normal subjects. Pleikart Stumpf (6) has sketched various types of normal waves in his original contribution on kymography. In comparing his illustrations with the wide variety of wave forms found in these cases of myasthenia gravis, it must be concluded that there is no cardiac roentgenkymographic wave form characteristic of this disease.

The reason for the change in wave form after prostigmine, however, remains to be explained. The literature contains no reports concerning the effects of prostigmine on the cardiac roentgenkymogram. The simplest explanation for the type of change in wave form in Figures 1 and 2 was suggested by the fact that the four patients

Roentgen Findings in Torulosis

Report of Four Cases¹

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TORULOSIS IS AN uncommon disease most frequently affecting the nervous system and the lungs, and less often the liver, kidney, and spleen. Infection of the lungs alone by *Torula histolytica* is of rare occurrence. We were impressed by the infrequent incidence of this disease at the Charity Hospital of Louisiana in New Orleans, in the records of which we were able to find only 4 proved cases among 537,135 admissions in the last ten years. These 4 cases are being presented in this report.

Perhaps the first true case of *Torula histolytica* infection was described by Busse (10) in 1894. The first proved infection in the lung was in a horse, the case and the method of culturing the organism being reported by Frothingham (22) in 1902. Following Frothingham's report, Stoddard and Cutler (50), in 1916, collected and reported 10 additional cases. Their excellent and accurate description of the clinical and pathologic changes in man due to *Torula histolytica* remains little changed to the present time. In 1931, Freeman (19, 20) and Freeman and Weidman (21) collected 43 cases from the literature. In 1937, Levin (35) brought the total to 60 and, in 1941, Binford (5) increased the sum to 75. Burger and Morton (7), in 1944, reviewed the literature and added 4 cases of their own, bringing the total to 100. Swanson and Smith (52) reported 2 additional cases, and Champion de Crespigny (13) one case. This brings the recorded number of cases that we were able to find to 103. Our 4 proved cases from the Charity Hospital of Louisiana make a total of 107, as of the present date.

Torulosis is known also as European blastomycosis and Busse-Buschke's disease. The etiologic agent is *Torula his-*

tolytica or, as it is sometimes called, *Cryptococcus neoformans*. It is a yeast-like organism belonging to the *Fungi imperfecti* and has been shown to occur normally in many types of grasses, insects, bees' nests, pickle brine, canned butter, and milk. Many non-pathogenic strains have been isolated from the throat, skin, and gastro-intestinal tract in normal, healthy individuals (8). The distribution is worldwide, cases being recorded from Germany, France, Italy, Australia, Japan, the Philippine Islands, the Dutch East Indies, Brazil, Argentina, Paraguay, and the United States.

Cultures of *Torula histolytica* do not ferment glucose (48), do not form endospores, and are best grown on Sabouraud's glucose agar, blood agar, or beef infusion glucose agar at 37° C. The organisms grow slowly (twelve hours to four days) and produce discrete, mucoid, slimy, white colonies early, which tend to become yellow to brown as they grow older (55). Microscopically the fungi appear as ovoid to spherical in shape, with thick walls, 5 to 20 μ in diameter. No definite nucleus is demonstrable, however, small darkly staining bodies may frequently be seen in stained smears. The thick-walled capsule in fresh specimens may be demonstrated easily by India ink preparations. Zenker, in 1861, described an organism of yeast-like nature from a pharyngeal infection. This seems to be the first reported description of an organism of this type affecting man.

Pathologically the organisms are mainly histolytic. So great is their power that many of the inflammatory cells following ingestion of the yeast-like bodies are destroyed by them. This process is respon-

¹ From the Department of Radiology, Charity Hospital of Louisiana at New Orleans, and Tulane Medical School. Accepted for publication in July 1946.

pear blurred and are often complicated by the distorting effect of transmitted ventricular pulsations. Aortic waves, although more distinct than auricular waves, are determined and influenced by such components as thrusts of blood from the left ventricle, contraction of the aortic wall, aortic tortuosity, and the effects of other stationary and moving mediastinal structures. We have observed pronounced changes, furthermore, in the aortic and auricular waves of normal persons due to relatively minor variations in the tube centering, placement of the subjects, and respiratory phase. These comments, however, are not meant to discourage the use of the kymograph. Rather is it our purpose here to reiterate the limitations and sources of error when an attempt is made to explain minor irregularities in the shape and contours of the individual kymographic waves.

CONCLUSIONS

1 There are no characteristic findings in the cardiac roentgenkymograms of patients with myasthenia gravis.

2 The prostigmine test dose produces no characteristic cardiac kymographic wave changes either in myasthenia gravis patients or in normal subjects. The test dose may slow the cardiac rate somewhat, thereby producing deceptive changes in wave contour.

3 Care and conservatism are urged in the interpretation of changes in the shape

and contour of individual kymographic waves.

NOTE The encouragement and help given by Dr Henry L Viets and Dr Laurence L Robbins of Boston in the preparation of this manuscript are gratefully acknowledged.

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and right mid-lung field and base. The lesions in the right lung field were said to have a radial distribution not typical of tuberculosis. Taber (53) dismissed the roentgen findings as indicative of some scarring. Levin (35) reported a case in which the roentgenogram of the chest showed several fairly well defined areas of cotton-like infiltration in the left base. There was also some increase in fibrosis in the lung fields on the right, particularly in the right base. A small indefinite area of infiltration was observed, about 1 cm in length, superimposed upon the third interspace anteriorly on the right.

We observed certain x-ray findings in cases of torulosis, which, while not pathognomonic of the disease, should strongly suggest the possibility of infection by a yeast-like organism such as *Torula histolytica*. When these findings are correlated with the clinical picture, we believe the diagnosis should be fairly certain. They were observed in all 3 of our 4 cases in which the lungs were involved. In one case, only the central nervous system was affected, while in 2 cases with lung involvement there were lesions in the central nervous system, also. One of these patients is alive three years and three months after the onset of his symptoms, while the other died in four months. Our fourth patient had pulmonary involvement alone. From the recorded medical literature it would seem that when the lung only is affected, the infection is not so nearly overwhelming as when the central nervous system is involved. This belief is borne out in our case, since the patient is asymptomatic at this time, eighteen months after the onset of his illness.

In roentgenograms reproduced in the literature, and in our own studies, we have observed that the disease has a predilection for the bases of the lungs. In 2 of our 3 cases with pulmonary involvement, the bases were first affected. In the third case the lesion when first observed was in the right second interspace. In all 3 cases, however, the early lesions presented a similar roentgen picture, and we wish to

emphasize that the early lung lesions offer the most favorable opportunity for a satisfactory roentgen diagnosis of torulosis. We found these to be fairly well circumscribed patchy areas of homogeneous consolidation, with only a small amount of reaction about their edges. These small areas of consolidation tend to become confluent as the disease progresses, with or without cavity formation, and with little or no demonstrable drainage. The lesions resemble closely those of tuberculosis. However, they tend to occur more frequently in the bases of the lung, where tuberculosis is only occasionally found. As healing occurs, small amounts of fibrosis remain in the affected areas. The lymphatic structures in the hilar region may show slight enlargement, not nearly so prominent as is seen in Boeck's sarcoid and certain forms of pneumoconiosis. Then, too, the associated involvement of the nervous system present in nearly all cases of pulmonary torulosis is a strong differential point against tuberculosis.

The lung lesions as observed roentgenologically suggest a fungous infection, and, when associated with symptoms of the cerebrospinal system, should lead to the inclusion of torulosis as one of the first-choice possibilities in the diagnosis.

CASE REPORTS

CASE I. A. G., a 52-year-old colored male, first entered Charity Hospital on Oct. 6, 1943, complaining of intermittent frontal headaches, which eventually became continuous in character. The headaches followed a rather mild respiratory infection, accompanied by a slight sore throat. At first they were relieved by aspirin (5 to 10 grains), although at all times the relief was only momentary. When the patient was seen in the admitting room, the headaches had become continuous and severe, and were relieved only by opiates. A slight cough, with a mucoid sputum, was present on admission.

Inventory by systems revealed nothing of significance except a chancre, years old, for which there had been no therapy. The patient was well developed but poorly nourished and did not appear acutely ill. Positive findings on physical examination were a stiff neck and positive Kernig and Brudzinski signs.

Laboratory examination revealed strongly positive Kahn and Kline reactions. The red blood cell count was 4,130,000, white cells, 8,150 (polymor-

sible for the ease of spread of the organisms to various organs

The central nervous system is mainly affected. In 83 of the 107 recorded cases, that system alone was involved. Here the lesions may be divided into three main groups, as classified by Freeman (19-21) (a) meningeal, with diffuse granulomatous meningitis, (b) perivascular, with small granulations or cysts in the cortex, (c) the embolic form, with deeply placed lesions in the cortex.

Involvement of the lung by torulosis is relatively rare. Only about 20 proved cases are recorded in which the lung and central nervous system were involved at the same time, and in only 4 cases in man was the lung involved alone. In cases in which the lung is affected, the fungi apparently gain entrance through the respiratory passages. In the process of reproduction they form a nodular, gelatinous mass which is the main lesion seen grossly. The nodule or nodules are firm and are frequently of the miliary type. They often coalesce and form abscesses or cavities, particularly if secondary invaders are present. The infection may spread by the lymphatic route, but the major spread is by the blood stream. The pathologic changes occurring in the lungs as a result of infection by *Torula histolytica* are reflected on the chest roentgenogram.

The age incidence of torulosis, as reported, ranges between four and seventy years, but it is most common between the ages of thirty and sixty. Clinically the disease is characterized mainly by symptoms of meningeal irritation, an increase in intracranial pressure, and a low-grade fever. Hence, headaches, mainly frontal, occur intermittently, gradually becoming more severe and continuous. Stiffness and pain in the neck, with vertigo and dizziness, are associated. As the disease progresses, severe mental depression, disorientation, restlessness, irritability, and delirium occur. Amblyopia, strabismus, nystagmus, ptosis, diplopia, and hemiplegia are frequent later symptoms. Physical examination discloses stiffness of the neck,

along with positive Kernig and Brudzinski signs. Enlarged nodes are often associated with torulosis, and, as such, may lead to confusion with Hodgkin's disease.

In cases of torulosis in which the lung is involved, a carefully taken history will usually reveal a previous respiratory infection, possibly quite mild. However, in those patients manifesting pulmonary involvement mainly, the respiratory symptoms will be severe. A bronchitis, with a cough productive of only small amounts of sputum, is typical. This form may yield a pneumonic type of infiltration in the lung, with corresponding physical findings. The easily mistaken diagnosis of tuberculous meningitis, non-specific meningitis, encephalitis, brain tumor or abscess, psychosis, or dementia paralytica is frequently made.

The laboratory findings may include a slight leukocytosis, increase in the sedimentation rate, and usually a hypochromic anemia. The spinal fluid will show an increase in pressure, it may be either clear or xanthochromic, with cells ranging from 3 to 1,000 per cu mm, but mainly from 200 to 500. There is an increase in both the albumin and globulin fractions. The organisms may be seen in direct smears as previously described, thick-walled, ovoid, spherical bodies showing up particularly well with India ink preparations. A meningitic type gold curve is commonly obtained.

While the pathologic findings in the lungs in torulosis have been well described, we have been unable to find any representative account of the roentgen finding. One of the early roentgen descriptions of such lesions was by Berghausen (3), who in 1927, stated that the diffuse bilateral infiltration in the lungs was not the typical picture of tuberculosis. A fluoroscopic examination of the chest of his patient showed diffuse enlargement of the nodes of the hilum and mottling of the parenchyma throughout. Sheppe (48), in 1924, had recorded a case of organizing bronchopneumonia, proved by necropsy, in which he described the chest x-rays as revealing a "nodose" involvement in the left upper

daily from 99 to 99.4°. The patient was variously treated with sulfadiazine, penicillin, potassium iodide, gentian violet, and finally roentgen therapy. A total dose of 450 r, in air, was administered over a period of seventeen days (200 kv, 0.5 mm Cu and 1 mm Al filters, a half-value layer of 1 mm Cu, 20 ma, distance of 50 cm) through two round ports 20 cm in diameter, centered over the lower lung fields posteriorly on each side. The plan of treatment called for a dose of 75 r (in air) three times to each of the two lung fields, one field a day alternately, for a six day period. This could not be carried out, however, because of the patient's inability to take consecutive daily treatments, and the course was prolonged over seventeen days.



Fig 2 Case II Patchy areas of consolidation in the left lower lobe. See Fig 3 for a view from the same case eight months later.

The patient was discharged on Oct 18, 1945, at which time roentgenograms showed improvement of the lesion in the left base, as evidenced by decrease in size and the presence of some fibrosis.

The patient was readmitted on Nov 5, 1945, with the same complaints as on his previous admission, namely, cough, chest pain, and in addition, hemoptysis. He was again treated with sulfadiazine and potassium iodide and left the hospital on Nov 14, 1945. He had several more admissions, each time the chief complaints being cough and blood streaked sputum. He was last seen on Jan 31, 1946, when roentgen examination showed the areas of consolidation, previously observed, to be replaced by a small amount of fibrosis. There was also regression in the size of the bronchopulmonary lymph nodes in the left hilar region.

CASE III W T, a 25 year old white male, was admitted because of headaches of six weeks' dura-



Fig 3 Case II The patchy areas of consolidation seen in Fig 2, eight months earlier, have now become confluent, with cavity formation.

tion. The headaches followed a respiratory infection for which a local doctor had given some nose drops, with no relief. About three weeks after the onset of symptoms the patient experienced some spontaneous relief for three or four days, soon after which severe headaches, vomiting, and slight stiffness of the neck developed.

Upon admission to the Charity Hospital, an inventory by systems was essentially negative. On physical examination, the patient appeared well developed and well nourished, somewhat flushed and ill. Positive findings were as follows: moderately stiff neck, positive Kernig and Brudzinski signs, with a questionable Babinski sign on the right.

Red blood cells numbered 5,150,000, white cells 9,700 (polymorphonuclears 75 per cent, lymphocytes 21 per cent, monocytes 2 per cent, eosinophils 1 per cent). The urine was essentially normal and serologic tests were negative. Spinal fluid examination showed an initial pressure of 80 mm of water, with 236 cells, and an increase in total protein as well as in the albumin and globulin fractions. There was a decrease in sugar, and no organisms were demonstrated on smears or cultures. Repeated spinal taps revealed very little difference in the findings except for some increase in the initial pressure. Repeated examinations of spinal fluid and sputum were negative for acid fast organisms.

Roentgenograms of the chest at this time showed several homogeneous, patchy, discrete areas of consolidation in both bases, with little or no reaction about their edges (Fig 4). Those in the left base progressed and coalesced in the course of several weeks, while those in the right cleared up with only a small amount of fibrosis remaining.

Bronchoscopy revealed nothing of significance.

During his stay in the hospital the patient had a

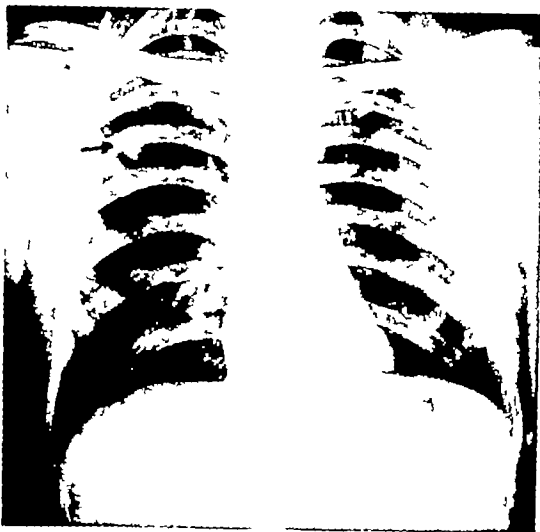


Fig 1 Case I A small rounded area of infiltration in the upper right second interspace. This represents a single lung lesion believed to be due to *Torula* infection

phonuclears, 76 per cent, lymphocytes, 22 per cent, basophils, 2 per cent, monocytes, none, eosinophils, none) Urine examination was essentially negative

A spinal tap on the day of admission revealed an initial spinal fluid pressure of 425 mm of water and 150 cells (70 per cent polymorphonuclears and 30 per cent lymphocytes) The albumin, globulin, and total protein were increased Sugar was decreased On repeated spinal taps these findings were essentially unchanged On Nov 9, 1943, *Torula histolytica* was found in smears of the spinal fluid and cultured Similar organisms were also obtained from the sputum Roentgenograms of the chest (Fig 1) revealed a fairly regular, homogeneous area of infiltration in the right second interspace. There was little or no reaction about this area and no demonstrable lymphatic drainage such as has been seen in tuberculosis

The course of the illness continued progressively downhill and cerebral symptoms eventually occurred—dementia, disturbances in vision, paralysis of the external rectus muscles, and finally failure of the pupils to react to light

Sulfadiazine was used in therapeutic amounts, and potassium iodide was also tried Many spinal taps were done to keep down the cerebrospinal fluid pressure, but death occurred on Dec 1, 1943 Autopsy was refused

CASE II C C, a 24-year old colored male, was first seen in September 1944, with an iridocyclitis and a beginning cataract In performing a paracentesis, the lens was nicked, and several weeks later the cataract was removed Physical and laboratory examinations were essentially negative except for

strongly positive Kahn and Kline reactions Fever therapy was given at this time.

The patient was readmitted on Feb 11, 1945, complaining of left sided chest pain, cough, and pain and swelling of both legs and ankles The cough was productive of a small amount of clear, mucoid sputum.

Inventory by systems was essentially negative. Physical examination revealed some increased breath sounds in the left base and slight swelling of both ankles There was some axillary lymphadenopathy, but apparently these lymph nodes were the only ones which were enlarged. Roentgenograms of the chest revealed fairly regular, patchy areas of consolidation in the left lower lobe which were beginning to coalesce (Fig 2) There was some enlargement of the bronchopulmonary lymph nodes on this side, and the impression was that of an early bronchopneumonia. The patient had a low grade fever, and a clinical diagnosis of Hodgkin's disease was made. Biopsy of an axillary node, however, revealed only adenitis with reticulum cell hyperplasia

At his own request, the patient was sent home several weeks later though not entirely symptom free

On April 8, 1945, he was readmitted, at which time he complained of a cough and pain in the left chest and in the scapular region The cough was again productive of a white, thick sputum There had been a loss of 10 pounds in weight in the past two months Cough had been present intermittently since the previous admission, and the patient was more comfortable when sitting or partially reclining

At this time the patient appeared somewhat lethargic but not acutely ill There was some lymphadenopathy Breath sounds were somewhat diminished in the left base posteriorly, with a few moist râles above this area. Other findings were essentially normal Temperature was 99.4°, pulse 102, respiration 30, blood pressure 105/70

The red blood cell count was 5,100,000, the white cell count 11,400, with an essentially normal differential count The urine was essentially normal Many sputum examinations and gastric washings were negative for acid-fast organisms The electrocardiogram was normal The sedimentation rate was 27 mm, and the Kahn and Kline reactions were now negative Roentgenograms of the chest showed extension of the previously described areas of patchy consolidation in the left base The discrete areas had now become confluent Progressive films revealed extension, and finally a cavity was demonstrated (Fig 3)

Physical examination showed some progression of signs of consolidation and fluid in the left base, confirmed by repeated roentgen-ray films There was progression of the lung lesion complete to consolidation in the left base, with some pleural fluid Smears and cultures of the removed fluid revealed *Torula histolytica*, the first organisms to be detected

The early temperature curve was of the septic type but this gradually became low grade running

daily from 99 to 99.4°. The patient was variously treated with sulfadiazine, penicillin, potassium iodide, gentian violet, and finally roentgen therapy. A total dose of 450 r, in air, was administered over a period of seventeen days (200 kv, 0.5 mm Cu and 1 mm Al filters, a half-value layer of 1 mm Cu, 20 ma, distance of 50 cm) through two round ports 20 cm in diameter, centered over the lower lung fields posteriorly on each side. The plan of treatment called for a dose of 75 r (in air) three times to each of the two lung fields, one field a day alternately, for a six-day period. This could not be carried out, however, because of the patient's inability to take consecutive daily treatments, and the course was prolonged over seventeen days.



Fig 2 Case II Patchy areas of consolidation in the left lower lobe. See Fig 3 for a view from the same case eight months later.

The patient was discharged on Oct. 18, 1945, at which time roentgenograms showed improvement of the lesion in the left base, as evidenced by decrease in size and the presence of some fibrosis.

The patient was readmitted on Nov. 5, 1945, with the same complaints as on his previous admission, namely, cough, chest pain, and, in addition, hemoptysis. He was again treated with sulfadiazine and potassium iodide, and left the hospital on Nov. 14, 1945. He had several more admissions each time the chief complaints being cough and blood streaked sputum. He was last seen on Jan. 31, 1946, when roentgen examination showed the areas of consolidation, previously observed, to be replaced by a small amount of fibrosis. There was also regression in the size of the bronchopulmonary lymph nodes in the left hilar region.

CASE III W. T., a 25-year-old white male, was admitted because of headaches of six weeks' dura-



Fig 3 Case II The patchy areas of consolidation seen in Fig 2, eight months earlier, have now become confluent, with cavity formation.

tion. The headaches followed a respiratory infection for which a local doctor had given some nose drops, with no relief. About three weeks after the onset of symptoms the patient experienced some spontaneous relief for three or four days, soon after which severe headaches, vomiting, and slight stiffness of the neck developed.

Upon admission to the Charity Hospital, an inventory by systems was essentially negative. On physical examination, the patient appeared well developed and well nourished, somewhat flushed and ill. Positive findings were as follows: moderately stiff neck, positive Kernig and Brudzinski signs, with a questionable Babinski sign on the right.

Red blood cells numbered 5,150,000, white cells 9,700 (polymorphonuclears 75 per cent, lymphocytes 21 per cent, monocytes 2 per cent, eosinophils 1 per cent). The urine was essentially normal and serologic tests were negative. Spinal fluid examination showed an initial pressure of 80 mm of water, with 236 cells, and an increase in total protein as well as in the albumin and globulin fractions. There was a decrease in sugar, and no organisms were demonstrated on smears or cultures. Repeated spinal taps revealed very little difference in the findings except for some increase in the initial pressure. Repeated examinations of spinal fluid and sputum were negative for acid-fast organisms.

Roentgenograms of the chest at this time showed several homogeneous, patchy, discrete areas of consolidation in both bases, with little or no reaction about their edges (Fig. 4). Those in the left base progressed and coalesced in the course of several weeks, while those in the right cleared up with only a small amount of fibrosis remaining.

Bronchoscopy revealed nothing of significance.

During his stay in the hospital the patient had a

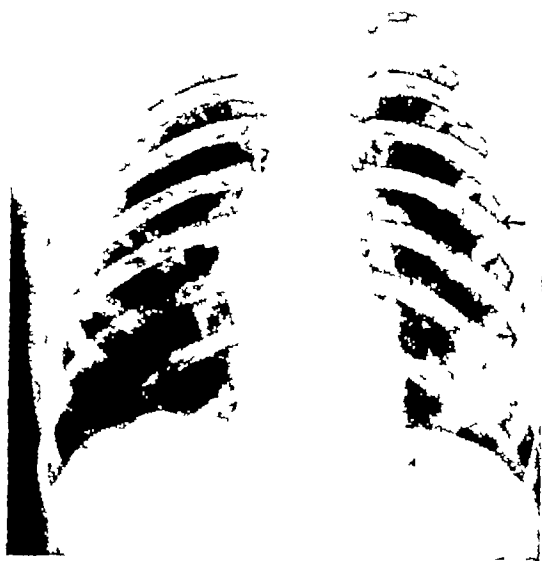


Fig 4 Case III Several homogeneous discrete patchy areas of consolidation in the left lower lobe. A single area of infiltration is observed in the left third interspace. For the same case three years later see Fig 5

low grade fever, the peak being about 99.6° F. Upon bed rest and adequate diet, with high vitamin supplements, he improved and left the hospital on March 18, 1943. The sole diagnosis was meningitis.

After leaving Charity Hospital, the patient went to the Mayo Clinic. There *Torula histolytica* was obtained from smears and cultured from both the spinal fluid and the material obtained from a bronchoscopic examination. Tyrocidin was given intrathecally with little effect. The patient was then given 45 grains of sulfathiazole daily for several weeks and sent home. There was some improvement in his headaches, but because of some gastro-intestinal disorder he stopped taking the drug. Since then he has been followed in the out patient clinic here, with several admissions to the hospital, upon which occasions the organisms have been found in the spinal fluid both on smears and cultures. He has received 7,000,000 units of penicillin and some intrathecally with no apparent effect.

The residual findings are bilaterally increased deep tendon reflexes in both lower extremities, an unsustained bilateral ankle clonus, an increase in spinal fluid protein, with a decrease in sugar. The patient has been working part time and getting along well except for occasional severe headaches (three years and three months following the onset of symptoms). The most recent roentgenogram of the chest showed the lesions at both bases to have cleared up leaving only a small amount of fibrosis (Fig 5).

CASE IV (in this case there were no pulmonary findings). E. M., a 6 year-old colored male, was admitted to the hospital on April 14, 1945 having had,

for two weeks, a mild respiratory infection, accompanied by vomiting several times, loss of appetite, and sore throat. On the day of admission the boy complained of a frontal headache and stomachache, and on this day he had a convulsion.

He was a normally developed child, with a birth weight of 5 pounds 12 ounces. He appeared poorly nourished and somewhat lethargic. Positive findings included enlarged and injected tonsils, some enlarged submaxillary lymph nodes, a stiff neck, and positive Kernig and Brudzinski signs. The red blood cell

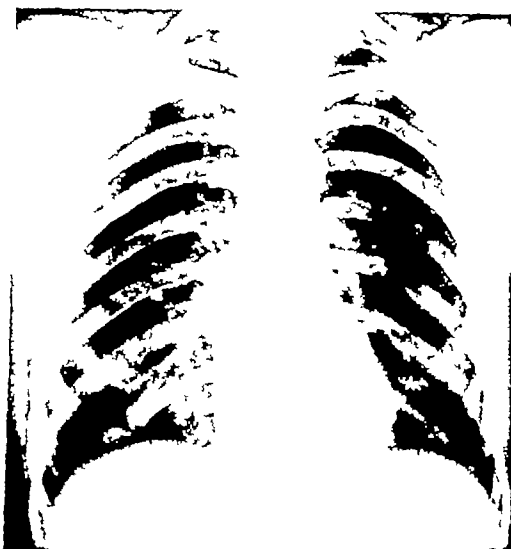


Fig 5 Case III The areas of consolidation seen in Fig 4, three years earlier have disappeared and are replaced by fibrosis.

count was 4,500,000, white cell count 13,120 (22% polymorphonuclears, lymphocytes 46 per cent, monocytes 4 per cent). The urine was essentially negative.

The spinal fluid was clear with a pressure of 104 mm. of water. There were 300 cells on the first tap, and this level was maintained on succeeding examinations. The Pandy reaction was 2 plus, and both albumin and globulin fractions were increased, sugar was normal. Roentgenograms of the chest were negative. Smears and cultures of the spinal fluid on Sabouraud's medium revealed the typical *Torula histolytica*. Injection of the fluid into a rat killed the animal in three days.

The patient was given intrathecal penicillin, sulfadiazine, and potassium iodide, but in spite of all medication he died on June 13, 1945. Autopsy was refused.

SUMMARY

1. Torulosis is an uncommon disease. Only 4 cases were found in 537,135 admissions to the Charity Hospital of Louisiana in New Orleans during a ten-year period.

2 When the lungs are involved, roentgenograms made in the early stage reveal small, circumscribed, patchy areas of consolidation which have a tendency to become confluent, with or without cavity formation

3 The bases of the lungs are most often affected by the disease

4 When healing occurs, it is by fibrosis

5 In one of the 4 proved cases recorded here, the lung lesion was single. It would appear that torulosis of the lung may be single, but most often is multiple

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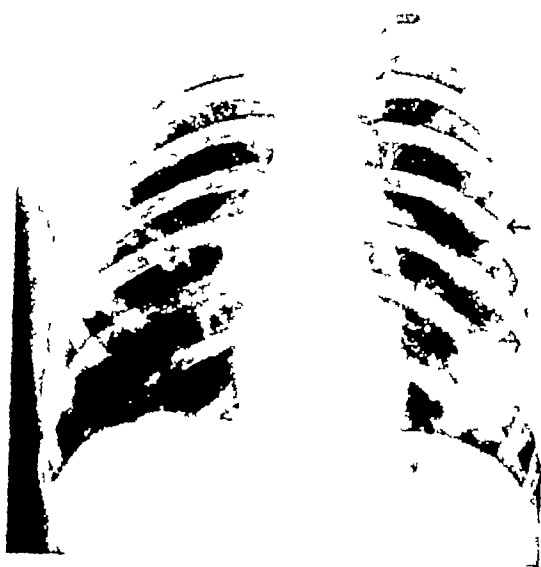


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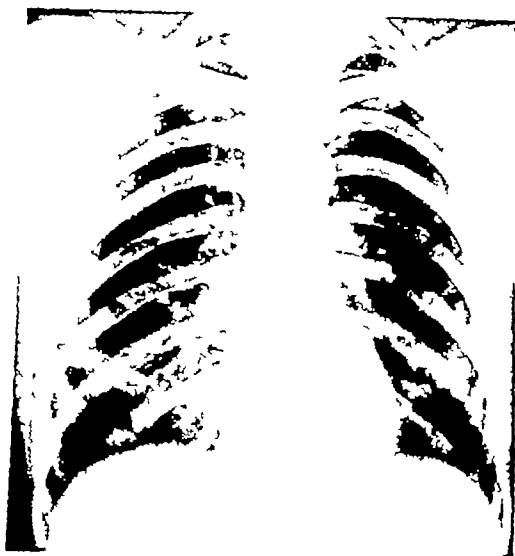


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A Study of 24,615 Separation Chest Roentgenograms¹

BERNARD J O'LOUGHLIN, M S, M D

Major, Medical Corps, Reserve

DISCUSSION OF chest x-ray and allied surveys of military personnel have stressed the importance of routine pre-induction and separation examinations to the taxpayer, the soldier, and the public health. These reports all look forward with interest to the next step—the post-war separation examinations. The results of such an examination are offered here. While previous surveys, by their nature, were only local in scope, the present study

scopic, lordotic, and stereoscopic techniques, were employed when indicated.

The findings on separation (Tables I–IV) are quite consistent with those on the induction examination, save for an expected increase in the number of intrathoracic metallic foreign bodies and a decreased incidence of active tuberculosis. As might be expected after the thorough screening at induction and the close medical observation of most Air Force person-

TABLE I COMPARATIVE STUDY OF TUBERCULOSIS BEFORE, DURING, AND AFTER ARMY SERVICE

	Separation Series		Rate per 1000 in Other Series			
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Advanced tuberculosis	2	0 0812	0 03	0 14		
Moderately advanced tuberculosis	10	0 406	0 19	0 6		
Minimal tuberculosis	10	0 406	1 41	5 0		
Undetermined activity	5	0 203	0 44			
Arrested tuberculosis of minimal extent not considered clinically significant (10)	903	36 6	1 44			
Miliary calcifications	8	0 324	0 34			
Tuberculosis of bronchus	1	0 04				
TOTAL ACTIVE TUBERCULOSIS	27	1 09	2 06	9 5	6 2	7 1

represents a greater geographic and economic cross-section, since the separatees are the entire output of an Air Force Auxiliary Separation Base. They are natives of every state in the nation, ranging in rank from colonel to private, representing virtually every nationality and race. The ages are from 18 to 44 years, those whose separation was deferred because of chest abnormalities are all in the 18 to 25-year group. No attempt is made to distinguish racial incidences—first, because of a technical difficulty, second, because the environment in the Army was the same for all races. Fourteen- by seventeen-inch, double emulsion, high-speed x-ray film was used and re-examinations, including fluoro-

nel, both active and apparently healed tuberculous lesions are comparatively few (Table I). Differences between enlisted and commissioned personnel were insignificant. Although many of the diagnoses were confirmed clinically or in the laboratory, most were based on the commonly accepted roentgen criteria. The classification used in Table I is that recommended by the National Tuberculosis Association with the exceptions noted. Five of the minimal tuberculous lesions of undetermined activity are still under observation. One patient with right upper lobe atelectasis was thought to have a bronchiogenic tumor until the bronchoscopist reported tuberculosis of the bronchus. All patients

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DISCUSSION

The percentage of men examined for separation at this field exhibiting active or questionably active tuberculosis—0.1 per cent—compares favorably with pre-induction surveys, which usually showed over 1.0 per cent active tuberculosis. Whether these men came into contact with and developed tuberculosis while in the service or whether old, apparently quiescent foci were re-lighted is a question worthy of investigation. The fact that none of the active lesions observed was of the primary type, and the fact that some of the men examined had never had pre-induction chest roentgenograms, may be considered as evidence that the disease was not acquired in the Army. None of the patients exhibiting active lesions had miliary calcifications in the parenchyma. Rigorous periods of combat and training, on the other hand, were experienced by many of the men with active lesions and may have served to cause recrudescences. These questions can better be studied at the General Hospitals to which the active cases have been transferred. There the pre-induction and subsequent roentgenograms may be compared and more time will be available to evaluate the medical history of each patient.

SUMMARY AND CONCLUSIONS

1 The significant abnormalities found in 24,615 chest roentgenograms made upon separation from Army service are tabulated and compared with pre-induction surveys

2 The incidence of active tuberculosis, although significantly lower than on pre-induction examination (average over 1.0 per cent), is still higher than might be expected (0.1 per cent)

3 The incidence of other abnormalities of the chest is almost identical with that found on previous surveys

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TABLE II OTHER DISEASES OF LUNG AND PLEURA

	Cases	Rate per 1000	Rate per 1000 in Other Series*
Primary atypical pneumonia	15	0 60	0 45 (6)
Pneumothorax (spontaneous)	5	0 203	0 25 (1)
Bullous emphysema	4	0 16	0 16 (6)
Bronchiectasis (probable)	4	0 16	0 8 (6)
Boeck's sarcoid	1	0 04	
Pneumoconiosis	1	0 04	0 11 (2)
Lobectomy	1	0 04	0 019 (6)
Atelectasis due to tuberculosis of bronchus	1	0 04	

* Figures in parentheses in this and following tables refer to Bibliography

having active tuberculous lesions (confirmed clinically and in the laboratory) or any communicable disease were transferred to a nearby Regional Hospital and separation was deferred

Table II lists the diseases of the lungs and pleura discovered, other than tuberculosis. The presumptive roentgen diagnosis of bronchiectasis was made on the routine chest film. In one case there was residual lipiodol. No confirmation has been received on the other three cases. The one case of pneumoconiosis is not a classical example. The peribronchial lymphatic chains were clearly outlined in calcific density but were not swollen or enlarged, and the parenchyma was essentially normal. Those men found to have primary atypical pneumonia and spontaneous pneumothorax allegedly had no symptoms. It is believed that complaints were suppressed in many cases in the fear that medical care would postpone or prevent separation. Diseases of the heart, mediastinum and diaphragm discovered in the course of the survey are listed in Table III, and skeletal diseases and abnormalities in Table IV.

Of the 24,615 men examined 23,537 were considered to have "no significant abnormality," a phrase advised by War Department Directive (10). "Significant abnormalities" in our opinion do not include simple tenting of the diaphragm, mild scoliosis, bifurcations or pseudarthroses of

TABLE III DISEASES OF THE HEART, MEDIASTINUM AND DIAPHRAGM

	Cases	Rate per 1000	Rate per 1000 in Other Series
Cardiac enlargement	27	1 09	5 2 (6)
Wide ascending aorta	5	0 203	
Mediastinal masses	5	0 20	0 2 (2)
Large epicardial fat pad	3	0 121	
Hepatic masses (clinical history of amebiasis)	3	0 121	
Dextrocardia	2	0 0812	0 3 (1)
Right-sided aorta	1	0 04	
Eventration of diaphragm	1	0 04	0 085 (6)
Herniation of diaphragm	1	0 04	0 1 (2)

TABLE IV SKELETAL DISEASES AND ABNORMALITIES

	Cases	Rate per 1000	Rate per 1000 in Other Series
Cervical ribs	14	0 57	1 7 (4)
Resected ribs	10	0 406	0 8 (4)
Scoliosis (over 2 cm)	7	0 27	3 1 (4)
Compression of dorsal spine	4	0 16	
Traumatic arthritis of dorsal spine	2	0 0812	
Cervical spina bifida	3	0 121	0 085 (6)
Cystic defect of ribs with peripheral sclerosis	2	0 0812	
Apparent non union of fractured clavicle	2	0 0812	
Acromioclavicular separation	2	0 0812	
Calcification of shoulder bursae	2	0 0812	
Osteoma of scapula	2	0 0812	
Multiple exostosis of ribs	1	0 4	
Miscellaneous			
Foreign bodies	8	0 324	0 1 (2)
Aerocele of larynx	2	0 0812	

the ribs, azygos veins, fibrotic apical caps, or a few discrete, well calcified nodules in the hilus or parenchyma of the lung. One other term suggested by higher authority (10), to be used with care, was "arrested tuberculosis of minimal extent not considered clinically significant."

A comparative study of significant chest x-ray abnormalities in other surveys is included in the tabulations of findings on separation from service. The source of the figures given for comparison are indicated by the series number and name at the top of each column. Series 5 is a survey of 32,000 soldier candidates for aviation cadet training, others are of pre-induction examinations.

DISCUSSION

The percentage of men examined for separation at this field exhibiting active or questionably active tuberculosis—0.1 per cent—compares favorably with pre-induction surveys, which usually showed over 1.0 per cent active tuberculosis. Whether these men came into contact with and developed tuberculosis while in the service or whether old, apparently quiescent foci were re-lighted is a question worthy of investigation. The fact that none of the active lesions observed was of the primary type, and the fact that some of the men examined had never had pre-induction chest roentgenograms, may be considered as evidence that the disease was not acquired in the Army. None of the patients exhibiting active lesions had miliary calcifications in the parenchyma. Rigorous periods of combat and training, on the other hand, were experienced by many of the men with active lesions and may have served to cause recrudescences. These questions can better be studied at the General Hospitals to which the active cases have been transferred. There the pre-induction and subsequent roentgenograms may be compared and more time will be available to evaluate the medical history of each patient.

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Aortic Aneurysm Secondary to Coarctation

Report of a Case Showing Calcification¹

STANLEY B CLARK, M.D and EDWARD C KOENIG, M.D

Buffalo, N Y

ANEURYSM of the descending aorta secondary to coarctation of the aorta has been reported frequently in the literature. This paper is not intended to cover exhaustively the problem of aortic coarctation, it does propose, however, to stress the radiographic diagnosis, not only by such conventional features as absence of the aortic knob, left ventricular enlargement, and rib notching, but also by the unusual finding of calcified ring shadows in the region of the aortic arch. In the case presented below, these ring shadows were not at first thought to be associated with the coarctation, subsequently, however, they were found to be areas of calcification in aneurysmal dilatations of the aorta below the coarctation.

Mrs B S, a 25-year old housewife, was first seen in the Out-Patient Department of the Buffalo General Hospital in March 1944, with diabetes, which she was known to have had since 1942. There was no history of illness referable to the cardiovascular system.

Physical examination revealed the following pertinent findings:

Heart The apex impulse was 30 cm outside the mid-clavicular line in the 7th intercostal space, there were no thrills, the character of the pulse was good, regular, and of pronounced intensity. The second aortic sound was greater than the second pulmonic sound. The blood pressure was 140/180.

Lungs Resonance was equal on percussion. Inspiratory râles were heard in the left bronchial area anteriorly, also posttussive râles in the left mid-chest.

Laboratory Studies The urine was acid, negative for albumin, and positive for glucose, a smear showed few red blood cells and many white blood cells. Blood glucose was 119-279 mg per cent. Serologic tests were negative.

Röntgen Studies Fluoroscopic and radiographic examination of the chest showed four calcified ring shadows in the posterior mediastinum at about the level of the aortic arch, varying from 1.75 to 5.0 cm

in diameter (Fig 1). These areas were non-expandible, and it was thought that the pulsations were transmitted from the aorta. In addition, the aortic knob was absent and the eighth rib on the left and the seventh and eighth on the right showed slight notching of their inferior surfaces posteriorly (Fig 1, A). The impression was coarctation of the aorta. The significance of the calcified ring shadows was not determined.

Course The patient became pregnant and on Jan 4, 1945, entered the Buffalo Children's Hospital, at term. Cesarean section was done on Jan 5, in view of the complications of diabetes and hypertension (blood pressure was 150/100 at this time). The immediate postoperative course was uneventful. On Jan 16, however, the patient began having chills, and her temperature rose to 103-104°. The abdomen was diffusely tender, especially in the right lower quadrant. Penicillin was administered intramuscularly, and transfusions of whole blood were given but the temperature again spiked to 102°. Physical examination revealed a mass in the right lower quadrant of the abdomen. An exploratory laparotomy was done on Jan 25, an abscess in the right broad ligament was drained, and sulfathiazole powder was dusted into the wound.

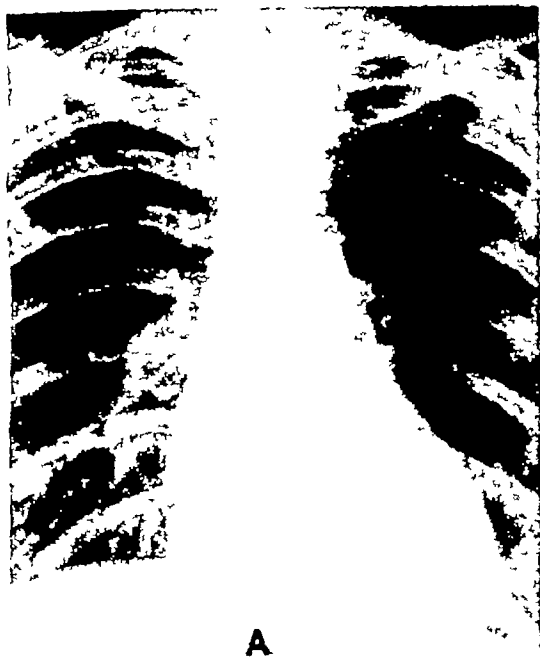
The patient improved until Jan 31, when the temperature again rose to 102°. She became cyanotic, respirations were rapid and shallow, and on Feb 1, she became comatose. Death occurred the following day. The terminal temperature was 107°.

Laboratory Findings The urine was positive for sugar, and occasionally positive for albumin, white blood cells, and urates. Blood glucose was 43-248 mg per cent. A portable chest film² again showed the calcified oval ring shadows in the region of the aortic arch, also the rib notchings. The lungs were clear.

Necropsy The postmortem examination (Dr Kornel Terplan) was restricted to the abdominal cavity and the thorax. For this reason, no dissection of the branches of the subclavian arteries was possible. Only the findings relative to the thoracic aorta, which were entirely incidental, will be given. The cause of death actually was a diffuse purulent peritonitis with subdiaphragmatic abscesses following purulent inflammation of the wall of the uterus and a fetid abscess in the right tubal angle several

¹ From the Department of Radiology, Buffalo General Hospital, Buffalo, N Y. Accepted for publication in July 1946.

² The authors wish to express their appreciation to Dr G Newton Scatchard of the Buffalo Children's Hospital for the privilege of viewing this film.



ous upper part of the descending thoracic aorta showed considerable aneurysmal dilatation, forming a solid, unusually firm protrusion along the medial contour of the vessel. The wall of this protrusion appeared calcified to the palpating finger. The aneurysmal sac was completely filled by firmly thrombosed blood. Only the left subclavian artery appeared moderately dilated, the other arteries, including the innominate artery, the right subclavian, and both carotid arteries, appeared of normal caliber (they were cut just at the exit from the aorta). When the descending aorta was opened, it could be seen that the intercostal arteries going off the thoracic aorta, especially the upper two pairs and in particular those on the left side, were of distinctly greater caliber than normal. The uppermost, immediately distal to the stenosis, measured 4.0 mm in diameter.

The drawings by Mr. Melford Diedrick, reproduced in Figures 2 and 3, show very clearly the relationship of the aneurysm to the aorta.

We have recently seen another case of coarctation of the aorta in a white male,



Fig 1 Postero-anterior lateral and oblique views of case of Mrs. B. S. Rib notching and calcification in the aneurysmal wall can be recognized

weeks after cesarean section. There was also some serous and purulent exudate in both pleural cavities and atelectasis with some inflammatory edema in both lungs.

Dissection of the aorta revealed extreme stenosis of the arch corresponding to or slightly below the level of the isthmus portion. The directly contiguous

age 42 years, whose chief complaints were aching legs and chest pain. His films showed certain interesting features which we believe merit mentioning. First is the multiplicity of rib notchings. The 3d to the 9th ribs bilaterally showed multiple

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notchings of the inferior surfaces posteriorly (Fig 4, A) This generally conforms to the finding of Bramwell and Jones, who in their series of cases noted that the notches were commonly confined to the ribs between the 3d and 9th, and absent in the first two and last three It has been shown by these authors and by Wolke, whom they quote, that notching is due to tortuosities of the intercostal arteries as a result of the collateral circulation The first two intercostals arise above the coarctation, from the subclavian by the superior intercostal Except for giving off large branches near their origin, which anastomose with the aortic intercostals, they play no part in the collateral circulation and do not become tortuous (Bramwell and Jones) The shorter collateral channels to the upper aortic intercostals naturally enlarge first, and this, according to these authors, is probably why notching seldom extends below the ninth rib

The second feature is the presence of a fusiform, soft-tissue density just distal to the coarctation, as seen in the left anterior oblique projection (outlined by arrows in Figure 4, B) This is interpreted as an aneurysm of the descending aorta, distal to the coarctation Also to be noted is the absence of aortic shadow proximal to this soft-tissue density Figure 4, C, is a postero-anterior projection and shows absence of the aortic knob

DISCUSSION

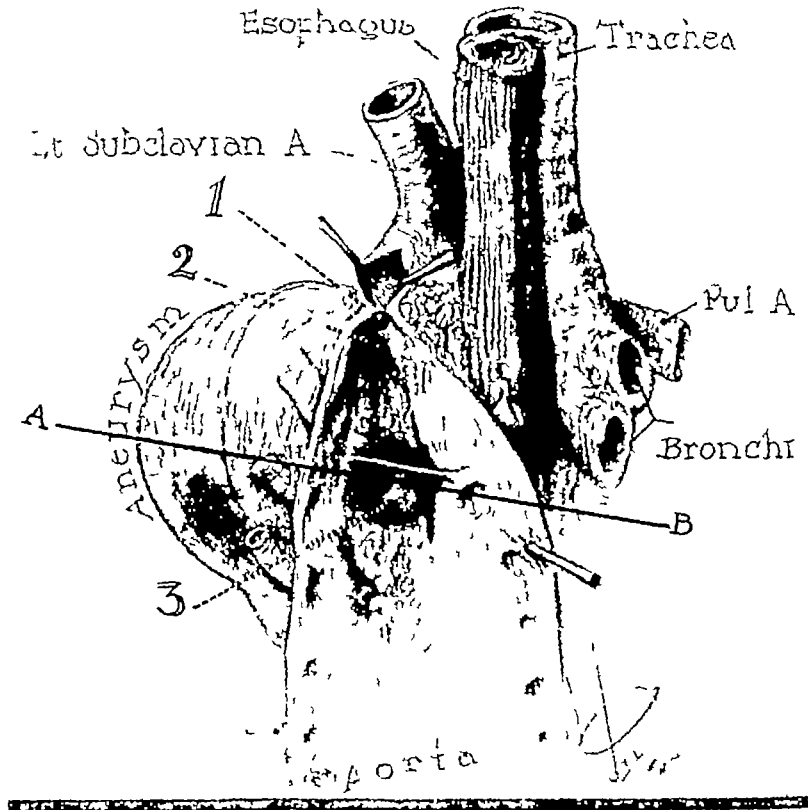
Roesler classifies aortic aneurysms according to their etiology as follows (1) embolic or mycotic, (2) arteriosclerotic, (3) rheumatic, (4) syphilitic, (5) due to coarctation of the aorta Aneurysms proximal to the point of stenosis occur relatively frequently (Abbott), and their etiology is apparent, however, until one appreciates the collateral circulation thereby established, aneurysmal dilatation distal to the coarctation may at first present an etiological problem

Bramwell and Jones beautifully demonstrated the collateral circulation by taking a series of roentgenograms during the in-

jection of barium paste into the common carotid artery of a cadaver known to have had coarctation of the aorta They concluded that there are four routes by which the blood can reach the aorta beyond the coarctation These collateral channels they term (1) *scapular and cervical*, in which the transverse scapular and transverse cervical, the posterior scapular and superficial cervical, and the long thoracic and subscapular arteries form an anastomotic network with the lateral and dorsal branches of the aortic intercostals, (2) *internal mammary*, in which the superior epigastric, the musculophrenic, the mediastinal branches and aortic intercostals anastomose with the deep epigastric branches of the internal iliac, phrenic branches of the thoracic and abdominal aorta, and terminal branches of the aortic intercostals, respectively, (3) *intercostal*, in which the terminal, lateral, and dorsal intercostal branches, and the first and second intercostals anastomose with the intercostal branches of the internal mammary artery, the subscapular and long thoracic arteries, the posterior scapular and the upper aortic intercostals, respectively, together with anastomoses between each intercostal with those above and below, finally (4) *spinal*, in which the spinal artery, being reinforced by blood from the vertebral artery, pours blood into the spinal branches of the aortic intercostals, and branches of the inferior thyroid artery join the spinal arteries

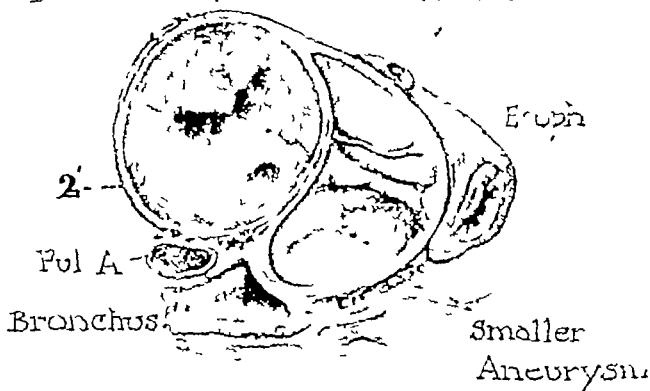
Abbott has stated that in certain cases there is frequently a bulbous dilatation of the aorta immediately below the constriction According to her, the dilatation may be so marked as to constitute a true sacular or fusiform aneurysm This is accounted for by the influx of returned blood at this point where the three upper aortic intercostals are given off

Nicolson described a case of coarctation of the aorta in a child with arrested subacute bacterial endocarditis, and a calcified mycotic aneurysm at the seat of the stricture She believes that mycotic aneurysms are found commonly immediately



Larger Aneurysm

Lumen of Aorta



Section thru Line AB above

Fig 2 Posterior view of the specimen after heart and lungs were removed and the descending portion of the thoracic aorta was opened 1 Marked stenosis of isthmus 2 Distinct erosion in the wall of the thoracic aorta caused by pressure from the upper portion of the sac where the aneurysm is secondarily corroding the aortic wall from without 3 Opening leading into the aneurysmal sac The short tendon like bridge crossing over this opening is apparently the last remnant of the intimal and subintimal tissue at the site where the aneurysm was formed It is obvious that the aneurysm had formed in a medial and somewhat anterior direction Note also the large caliber of the upper three branches of the intercostal arteries

Fig 3 Section along the line A B in Fig 2 in a fairly transverse plane with the upper segment of the aneurysm and the aorta The firm calcification in the wall of the aneurysm is clearly seen The largely organized firm thrombosed material has fallen out exposing the uneven somewhat shrunken firm plaques in the calcified wall of the aneurysm 2' corresponds to the point of erosion denoted by 2 in Fig 2

distal to the point of narrowing because of kinking and wrinkling of the aorta secondary to the eddying currents here This is likewise the belief of Zaslów and Krasnoff, who report a case of aneurysm of the aorta distal to a coarctation with rupture in a 25-year-old white male In Abbott's experience, rupture distal to the coarctation occurs less frequently than rupture proximal to the coarctation

The establishment of eddying currents immediately distal to the coarctation apparently predisposes to superadded infection in this region from micro-organisms circulating in the blood stream (*Streptococcus viridans*, rarely, also, pneumococci) This results in the formation of a so-called mycotic aneurysm Abbott believes that mycotic aneurysms are a "grave danger" that attend the presence of the adult type of coarctation

It would seem that the majority of aneurysms distal to the stenosis are formed directly as a result of the collateral circulation secondary to the coarctation and are not related to infection

SUMMARY

1 A case of coarctation of the aorta, including the postmortem findings, is presented, which radiographically showed calcified ring shadows in the region of the aortic arch

2 Certain interesting radiographic features of a second case are discussed

3 The collateral circulation attending coarctation of the aorta is presented

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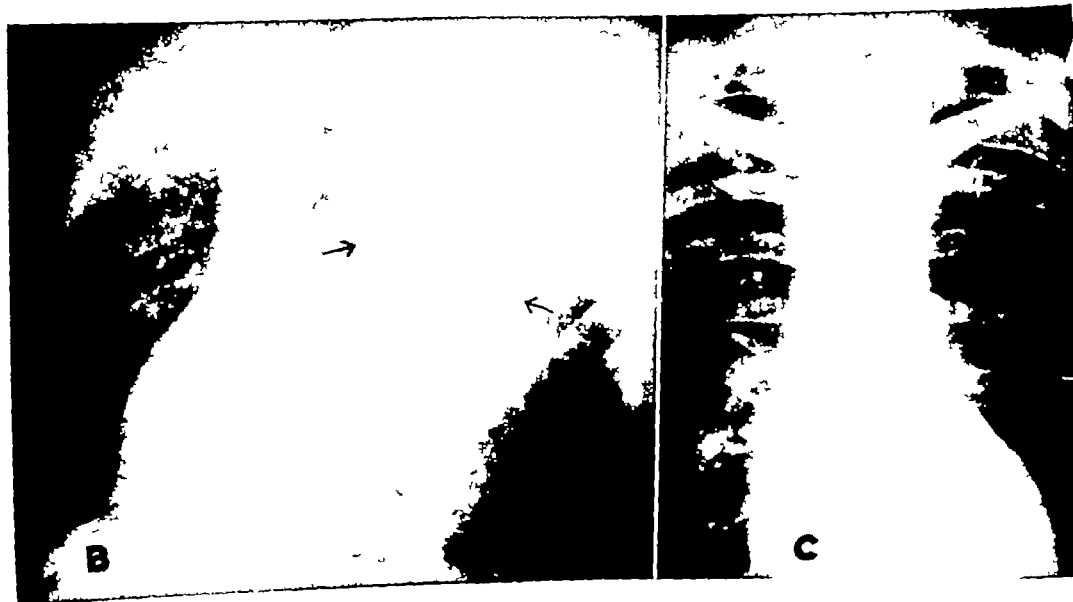
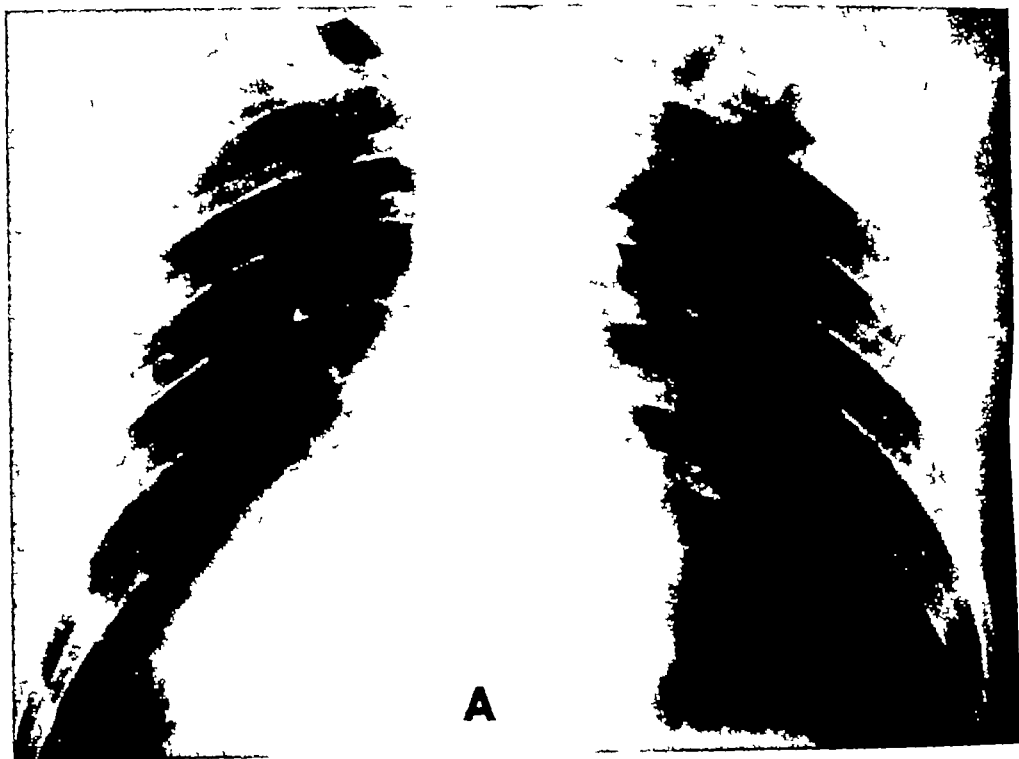


Fig 4 Views of second case Marked rib notching and absence of the aortic knob can be seen in the posterior view Aneurysmal dilatation is marked by arrows in B anterior view

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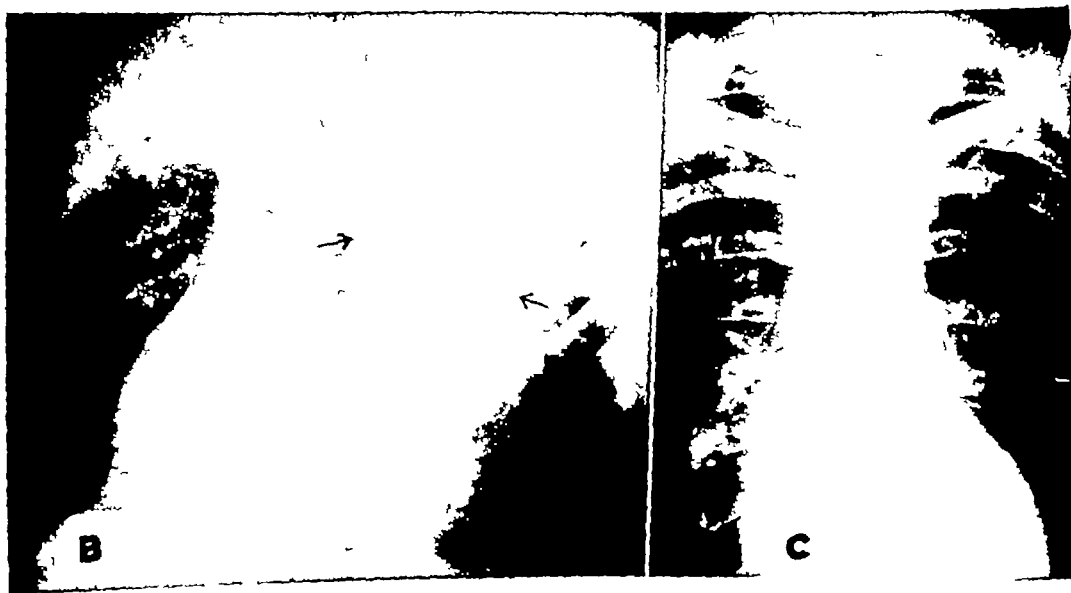


Fig 4 Views of second case. Marked rib notching and absence of the aortic knob can be seen in the postero-anterior view. Aneurysmal dilatation is marked by arrows in B.

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Problems of Acquired Radioresistance of Cancer.

Adaptation of Tumor Cells¹

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EXPERIENCE shows that malignant tumors of various microscopic structure which respond to initial irradiation may lose their radiosensitivity in part or whole during or after radiation therapy. Thus, they acquire various degrees of radioresistance, which, in the opinion of many observers, is one of the main causes of failure of radiation therapy.

Little is known of the causes of this interesting and obviously important phenomenon. Ferroux, Regaud, and Samsonow (10), in experimental studies, found no demonstrable structural changes associated with decreased radiosensitivity of tumors. The various opinions in this field (2, 3, 13, 20, 21, 23) may be summarized as follows.

1 According to one theory, there is a certain selection of tumor cells present during the course of the first irradiation. The more sensitive cells become disintegrated and the more resistant ones retain their vitality. It has been assumed that each tumor consists of a conglomerate of resistant and sensitive cells which cannot be differentiated microscopically. The resistant cells are not destroyed in the course of irradiation and they are the seed for the growth of a new, more resistant cell strain (10, 23).

2 The hypothesis of induction, by irradiation, of a biological mutation of the cancer cells, *i.e.*, a change in their "character," was advanced as early as 1905 (24). It has been stated, for instance, that an alveolar cancer of the breast became scirrhous after roentgen irradiation. This theory has had many followers, and the belief has been repeatedly expressed that after irradiation a new type of radioresistant cell may develop (20).

3 According to still another view, a functional change affects the connective tissue in which the neoplastic cells are embedded. Injured by irradiation, this no longer reacts to the presence of the tumor and no longer hinders the relentless growth of tumor cells (13). A number of investigators (16, 17, 18) believe that connective-tissue damage by irradiation may be present even though no microscopic signs of retrogressive changes are observed.

The phenomenon of radiologic induction of biological mutations has been attributed by early French authors to a common property of the radiant energy, namely, that of producing more highly differentiated structures from anaplastic and less highly differentiated tissues (*maturation évolutive*). Increased cornification of the epithelium of the skin and transformation of squamous epithelium of mucous membranes into excessively cornified epithelium after irradiation are well known.

The microscopic demonstration of the development of cornified structures, following irradiation, in basal-cell cancers (23), which as a rule do not cornify, substantiates this theory to a certain extent. I have had frequent opportunities to corroborate these observations. Cathie (3), who also described keratinization and transformation of basal-cell tumors into prickly-cell structures, stated that with this change of structure, the sensitivity of basal-cell cancers decreases correspondingly to the level of squamous-cell cancers. Newell (15) doubts, however, that such a difference in sensitivity exists.

The observations which enable me to express an opinion of the causes of acquired radioresistance of tumor cells on a cyto-

¹ From the Department of Radiology, Stanford University School of Medicine San Francisco Calif
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physiological basis were made on the epithelium of the human larynx irradiated for cancer (27). They can be briefly summarized. In the *first phase* of irradiation, at the height of fibrinous reaction, the cells of the epithelium are entirely destroyed. In the *second phase*, the epithelium is regenerated but is metaplastic, revealing epidermoid and markedly cornified structures. In the *third phase*, the epithelium, as a rule, becomes atrophic, advanced squamous metaplasia persists in those cases in which the subepithelial connective tissue has undergone hyaline sclerotic transformation. If excessive doses are administered, ulcerations develop. These remain superficial if the subepithelial connective tissue is not transformed as described above. In 2 out of 10 cases, the newly formed metaplastic epithelium exhibits a definite tendency toward atypical growth into the depth of the connective tissue. In these instances no changes of connective structures are evident.²

From a radiobiological point of view, cornified squamous epithelium must be considered in relation to the original epithelium as a functionally more highly differentiated and, therefore, more radio-resistant tissue (see above). If a new cancer develops from such highly differentiated metaplastic epithelium which has proliferated during irradiation, this cancer is likely to be more resistant to irradiation than the original tumor developing from the non-irradiated and less differentiated structures.

In the past, observations made it reasonable to believe that basic changes in morphology and radiobiology of the epithelium could be successfully compared with neoplastic proliferations of this tissue, namely with malignant squamous or transitional-cell or basal-cell tumors (1, 4, 17, 18). The epithelium may therefore be con-

sidered a suitable test object for the study of biological changes which take place in epithelial cancer during and after irradiation.

In comparison with the cyclic alterations in the epithelium, it becomes conceivable that alternating changes of destruction and regeneration take place within the irradiated tumor and that these are associated with cellular metaplasia. The final results of this are as follows: (a) progressive atrophy of changing cell generations, with final disintegration of the tumor and clinical cure, or (b) development of a more highly differentiated, radio-resistant cell strain associated with clinical arrest of growth and presence of a "residual" tumor, or (c) formation of a new cancer from the radioresistant cell structures, first in the tumor bed itself and later in adjacent structures, and clinical progress of the tumor growth.

We do not possess microscopic criteria which would indicate the final degree of radiosensitivity of the tumor cells as related to the susceptibility of the primary cell structures. Due to the close proximity of cells of different age, vitality, morphology, and degree of differentiation in the same tumor, the different phases of cellular metaplasia and radiobiological metamorphosis cannot be followed in the cancer as they can in microscopic studies of the epithelium of the larynx or in simple experiments. An exception is the cornification of squamous-cell and basal-cell tumors.

In the epidermis, cell regeneration occurs during or after protracted fractionated irradiation from cells of the basal layer, which are considered to possess greater radiosensitivity than more highly differentiated structures of the epithelium. Consequently, in order to understand the continuous proliferation of epithelial tissue from this germinative layer, in view of its maximal radiosensitivity, we must assume that parts of this layer become adapted early to radiant energy and maintain their reproductive capacity.

In connection with this observation, it is likely that regeneration of tumor cells

² Generally the regenerated epithelium of the larynx exhibits a tendency to atypical growth in the presence of chronic inflammatory changes in the subepithelial connective tissue. These develop in the larynx chiefly in cases of chronic tuberculosis. Goldzieher described precancerous epithelium of the larynx after diphtheria also.

takes place during and after irradiation from germinative cells which are not necessarily residuals of primarily resistant elements. It is more probable that they develop from cells which, from generation to generation, increasingly adapt themselves to radiant energy and to nutritive conditions produced by irradiation in the environment of the tumor. Their sensitive biological phases, the mitoses, may take place during the after effects of irradiation on structures surrounding the cells, therefore, a new cell strain may arise which, while still *in statu nascendi*, is exposed to the direct or indirect influences of radiant energy, to which it subsequently adapts itself.

I propose to define the adaptability of tumor cells as their property of changing their metabolic requirements in consecutive cell generations, according to prevailing conditions. The latter may differ considerably from those present at the place and time of origin of the tumor. They may include spontaneous variations of the biological *milieu* if the tumor invades heterotopic tissues, as well as pathological changes induced by radiant energy in the surrounding structures.

Little is known concerning the adaptability of tumor cells except its effects as indicated by the basic ability of malignant tumor cells to grow and to reproduce in a tissue entirely different from the primary stroma (heterotopic growth). The process of adaptation, therefore, is unrelated to the phenomenon of recovery of irradiated tissues, with which it has been repeatedly confused. The inherent potentialities of normal epithelial cells to adaptation are exhibited in their property of producing metaplasias.

Not only the faculty of malignant tumors to grow heterotopically, but also their capacity to form metastases, favors the conception of adaptation. Emboli of tumor cells in lungs and liver are quite frequent in the presence of a primary malignant tumor. Most of these emboli become disintegrated without forming metastases. Only those cells will produce metastatic

foci which are able to adapt their metabolism to conditions prevailing at the site of their innidiation. Moreover, it has recently been shown that the frequency of formation of remote metastases is in direct relation to the ability of the tumor to form discontinuous local metastases in the vicinity of the primary focus. This can be comprehended only when it is considered that extension into heterotopic tissue or formation of local discontinuous metastases not only indicates the powers of the tumor for adaptation but shows that some cells are already adapted to the changed environment. These cells are more likely to survive not only in tissues in the immediate vicinity of the tumor but also in distant organs such as lymph nodes, liver, lungs, etc. Hence, these are the cells which most frequently become the matrix of metastases. In this connection it is worth while mentioning that occasionally basal-cell cancers appear in metastases as squamous, cornifying carcinomas.

Another factor often considered as decisive in the development of remote metastases, namely, the general deterioration of the host, could not explain why in many instances early metastases are produced by relatively small tumors, for instance small gastric carcinomas, prior to the presence of clinical signs of deterioration of the patient. A sudden spread of metastases in the terminal stages could be explained by accentuation of the effects of adaptation through decreased resistance of tissues of the host.

There are many indications that when a tumor cell adapts its metabolism to a heterologous tissue, it simultaneously adapts its radiosensitivity as well. Whether this is due to the presence of a common factor simultaneously influencing cellular metabolism and specific radiosensitivity or whether the change of radiosensitivity follows alterations of metabolism cannot be decided from our studies. It seems, however, that the capacity of the tumor cells to adapt themselves to one vicissitude is persistently correlated with the capacity to adapt to another. Close

relationship between intensity of metabolic activity of cells and their radiosensitivity is an established fact. In this connection the following generalizations may be enumerated:

1 Any tumor reveals decreased radiosensitivity if it invades different tissues from those surrounding it at its place of origin. For instance, a squamous-cell tumor becomes less sensitive if it grows into cartilage, muscle, fat, bones, or into connective tissue, functionally different from its original environment.

2 Metastatic growths are, as a rule, less sensitive than the primary tumor.

3 If diffuse irradiation is used, the same focus of tumor growth (alveolus) is more resistant in its peripheral portions, where its metabolism is adapted to the surrounding connective tissue, than in the central portion, where it often exhibits signs of spontaneous retrogression.

4 Tumors which possess an abundance of connective-tissue stroma adapt their metabolism to nutritive conditions provided for them by the excess of collagenous tissue, which is highly radioresistant. The simultaneous change in their radiosensitivity explains why a scirrhous adenocarcinoma, for instance, is less sensitive than a solid alveolar adenocarcinoma.

5 Epithelial tumors which do not have the intrinsic ability to develop more highly differentiated and consequently more resistant strains, such as many anaplastic tumors, are apt to retain their radiosensitivity as long as they remain localized in the tissue of their origin. However, if they have the capacity to adapt themselves to surrounding tissues and invade adjacent heterologous structures, they become more or less resistant to irradiation. A good example is the behavior of anaplastic cancer of the cervix, the sensitivity of which is considerably decreased if it invades, for instance, the adjacent wall of the vagina. The experience in such cases cannot be vitiated by restriction of the physical dose, as it is in some other situations. The vaginal wall is accessible to the very same dose which is delivered at the cervix itself.

The author adds the following conclusions from his experience:

During radiation therapy, the connective stroma is included in the irradiation and often becomes replaced by structures whose radiosensitivity is much lower than that of the primary non-irradiated connective tissue. Consequently, if tumor cells regenerate after primary injury by radiation, the new cell strain must be considered as being, to a certain extent, already adapted not only to the radiation, but simultaneously to nutritive values of connective stroma which itself has changed under the influence of radiation. Otherwise, the tumor cells could not survive the primary radiation effect and would die.

If the tumor surroundings are so altered (fibrosclerosis) that the nutritive effect of this change cannot be overcome by the adaptability of tumor cells in successive generations, the tumor growth will finally stop and the cell strain will die (clinical cure).

We do not know what adaptive mechanism is at the disposal of the tumor cells other than their ability to form strains of various degrees of differentiation which survive and grow under conditions in which the primary strain would die. (Compare certain forms of metaplasia of normal epithelial tissues.) Most tumors exhibit no microscopic signs of changed differentiation during and after irradiation, nor is it possible to determine microscopically which part of the cytoplasm, nucleus, or cell as a whole has changed during the process of metabolic and radiobiological adaptation. We see only the consequences of this process, namely, the survival, growth, and reproduction in conditions often basically different from those at the site of origin of the tumor itself. (See also Borak.)

It is pointed out in the present communication that concomitant with changed metabolic adaptation of tumor cells to their surroundings, there is an alteration in their radiosensitivity, which, as a rule, is decreased, under different conditions, to various degrees. This changed sensitivity, also called "derived sensitivity" (8), is

takes place during and after irradiation from germinative cells which are not necessarily residuals of primarily resistant elements. It is more probable that they develop from cells which, from generation to generation, increasingly adapt themselves to radiant energy and to nutritive conditions produced by irradiation in the environment of the tumor. Their sensitive biological phases, the mitoses, may take place during the after effects of irradiation on structures surrounding the cells, therefore, a new cell strain may arise which, while still *in statu nascendi*, is exposed to the direct or indirect influences of radiant energy, to which it subsequently adapts itself.

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The histologic and radiobiologic behavior of the mucous membrane of the larynx after irradiation may be used as a test experiment for radiobiologic conditions present in the irradiated cancer. Microscopic examination shows that cells of laryngeal epithelium are primarily destroyed by irradiation and that a new and more highly differentiated metaplastic epithelial structure develops after disintegration of the original mucous membrane. This newly developed epithelium possesses lower radiosensitivity. Its cells are characterized by (1) ability to regenerate under doses of irradiation which previously destroyed them, (2) a higher degree of differentiation, (3) a capacity to adapt their metabolism to the nutritive changes of the irradiated, subepithelial connective tissue. Thus the regenerated epithelium displays signs of increased radioresistance.

It is very likely that similar changes take place in the tumor itself. The radiant energy destroys primarily many of the tumor cells, however, a new strain of cells develops from structures which, in the nascent state, were exposed to the direct or indirect effects of irradiation. The new cell generations gradually become more highly differentiated. A change in their radiosensitivity occurs, corresponding to this new degree of differentiation and to the capacity of cellular adaptation to the nutritive properties of the adjacent simultaneously irradiated connective tissue. Tumor cells which are able to adapt themselves maintain their newly acquired properties in successive cell generations. Gradually the entire tumor becomes transformed into a growth, the radiobiological properties of which are adapted to the biological conditions prevailing during and after irradiation. In this new surrounding, the tumor either disintegrates or its radioresistance is increased. The decrease of radiosensitivity of most of the metastatic tumors, of tumors invading muscle, fat, cartilage, bones, etc., finds a natural explanation in their ability to adapt their metabolic and radiobiological properties to those of the new host

tissue which is, as a rule, more radioresistant. Anaplastic tumors, which are unable to produce more highly differentiated structures, remain sensitive and disintegrate, due to the direct effect of radiant energy, as long as they grow in their original matrix, however, as soon as they invade heterotopic tissues (displaying their capacity for adaptation), their radiosensitivity decreases. It seems reasonable to assume that "residual" tumors after irradiation, and recurrences of irradiated tumors, must be regarded from a radiobiological standpoint as metastases developing in the bed of the primary tumor, for their growth occurs in a tissue modified to a variable extent by previous irradiation. This modified tumor bed may be considered structurally and radiobiologically as heterotopic tissue, thus explaining the loss of radiosensitivity of "residual" and recurrent tumors.

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thus related to metabolic activity of the tumor cells and to their capacity for adaptation

More than ten years ago, I called attention to the important interrelations between cyclic changes of the mucous membrane of the larynx and the radiosensitivity of epithelial cancers (26). Not long ago, Ewing (7), after studying the behavior of the regenerated epidermis following irradiation, came to the conclusion that normal epidermis may acquire resistance to the roentgen ray by a process of adaptation and is able to grow under a dosage which originally destroys the pre-existing epidermis. Ewing believed, however, that tumor cells subjected to exactly the same dosage do not exhibit that power of adaptation and regeneration but perish, differing in this respect from normal cells. The cure of cancer seems to depend upon this difference in adaptation, for normal epidermis may regenerate, whereas cancer does not. A consideration of adaptation and regeneration of connective tissue is emphasized as necessary to an understanding of regression of deep parts of the tumor (7, 14).

Our observations show that tumor cells display notable adaptive properties and therefore mostly escape from destruction. They die only if their adaptability cannot overcome the loss of nutritive qualities of the irradiated, adapted, and regenerated connective-tissue stroma.

Recent experimental studies of Failla (8) appear to support this finding. He observed *in vitro* that the nature of the medium in which the tumor cells are found following irradiation (comparable with irradiated stroma) exerts an influence on cell damage. The radiosensitivity manifested by a tumor is the result of an inherent radiosensitivity possessed by its cellular constituents and of a derived radiosensitivity depending for its degree on the characteristics of the medium (stroma, environment of tumors).

The conclusions of Failla, drawn from *in vitro* experiments limited to experimental cancer strains, are thus similar to

those of this author based on histologic studies on human tissue. According to Failla, the derived radiosensitivity of tumor cells is induced, consequently, these cells must possess adaptability, without which no changes in sensitivity can be induced. His conclusion that these changes are influenced by the characteristics of the medium are entirely in accord with the results of morphologic examination following irradiation. The latter shows that the medium consists of connective tissue changed by irradiation, or of heterotopic structures.

The above observations and conclusion do not stand in contradiction to older beliefs enumerated in the first part of this article. However, the theory regarding survival of the more resistant of mixed cells present in malignant tumors may well be modified. It may be stated, therefore, that increased resistance of the surviving cells is not intrinsic, but is acquired by irradiation and inherited through successive generations in the presence of the capacity of the tumor cells to adapt themselves to the changed *milieu*. It is of no basic significance in this connection whether the radiobiologic adaptation is directed toward an area of primarily and constitutionally radioresistant tissue invaded by the tumor (cartilage, muscle, fat) or toward a zone which has itself become radioresistant following irradiation (sclerotic connective stroma). The author believes, with Borak, that the native behavior and primary radiosensitivity of tumor cells are congenital and constitutional and depend to a great extent upon the radiosensitivity of the cells of their origin. The sensitivity of the tumor cell, however, may be modified by adaptation to its changed surroundings. This acquired modification is maintained as long as the modifying conditions remain unchanged.

CONCLUSION

An attempt has been made to analyze the cause of acquired radioresistance of malignant tumors on a cellular basis.

EDITORIAL

The Teaching of Radiology

With the post-war resumption of the Annual Conference of Teachers of Clinical Radiology, the problems of undergraduate and postgraduate training in radiology will receive attention that was necessarily diverted to other fields for the period of hostilities. In this connection some reflections presented by James F. Brailsford in the Twenty-Second Mackenzie Davidson Memorial Lecture before the British Institute of Radiology¹ are particularly pertinent. This address presents a challenge to all of us to stop and consider the problems which radiology has surmounted and the course to be charted for the future.

No longer, Brailsford believes, should we welcome to radiology all who show an interest in the subject, regardless of their qualifications. "There are ample reasons," he says, "for believing that the time has now come when we have a right to ask those who wish to use radiology in medical practice to show evidence that they have received a recognized course of training." These ample reasons are to be found in certain "abuses of radiology," which he proceeds to discuss under five headings: (1) neglect of clinical methods by the substitution of more rapid radiological examinations, (2) the time for an x-ray examination, (3) the desire of the spectacular, (4) useless and undesirable radiography, (5) interpretation without knowledge.

In his discussion of the first of these abuses, Brailsford forcibly calls attention to the decline of basic clinical studies in favor of the less time-consuming radiological examination. A diagnosis made solely on x-ray evidence without careful evaluation with the aid of clinical observations may react to the detriment of

the patient. Too often symptomless lesions brought to light by radiologic studies have led to surgical exploration which is not only unjustifiable but actually detrimental. Such lesions, when studied over a number of years by able clinicians, with the aid of serial radiographs, have frequently been shown to remain unchanged or relatively so. Brailsford's feeling that the x-ray tube may become discredited if carelessly employed as a time- and thought-saving instrument to the neglect of the more important clinical investigations may well be shared by all thoughtful radiologists.

The second abuse concerns the time at which the examination should be done. In many instances there is a demand for radiographic examination immediately after a serious injury, while the patient is still in shock and before any attention is given to the wound. Not only may this harm the patient, but the radiographic findings are likely to be entirely inadequate in the absence of a preceding physical examination. All of us can recall instances in our own practice when a delay in radiographic examination would have been advantageous. In this connection Brailsford again calls attention to the latent period between the time of the onset of disease and the development of signs recognizable on the roentgenogram, a subject which he has discussed editorially in the columns of this journal (46:184, 1946). Cognizance should also be taken of the fact that improvement of the clinical signs may far outstrip improvement in the radiographic appearance.

The desire for the spectacular, which is designated as the third abuse, is exemplified by the ill-advised use of contrast sub-

¹ Published in *Brit. J. Radiol.* 18:249, August 1945.

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stances to visualize structures which are not readily demonstrated on the plain film. This, says Brailsford, should never be done until the patient has a thorough clinical examination and routine radiographs which have been interpreted by a competent observer, for these may provide all the information that is required.

Closely akin to the third abuse is the fourth, namely, useless and undesirable radiography. Under this head are included distressing and painful investigations in cases of hopeless carcinomatosis or other incurable affections, as well as multiple examinations at such brief intervals that no appreciable change in the picture can be expected.

Interpretation without knowledge, the fifth of Brailsford's abuses, is one that concerns every radiologist. Under this heading he describes the many mistakes which may be made—and too often have been made—by those with insufficient knowledge both of clinical medicine and

radiology. Adequate training is the rock on which radiology stands, and the determination with which this point is defended by the Board of Radiology will largely determine the respect in which our specialty will continue to be held.

Throughout this lecture Brailsford continually stresses the need of clinical training for those practising radiology, which is as it should be. The radiologist must be able to explain the clinical significance of his findings or he must pass this responsibility on to the clinician. The latter course cannot but jeopardize the position which the radiologist should occupy. This, to be sure, is apparent to those of experience, but too often its deeper significance is overlooked. It means not only that we must ourselves keep abreast of clinical practice, but that those of us upon whom the education of future radiologists depends must insist upon a sound clinical grounding as a basis for training in the specialty we represent.

Malpractice Honest Difference of Opinion among Physicians as to Proper Method

Under the above title there has recently been published in the *J A M A* (132:350, Oct 12, 1946) a medicolegal abstract which should be of particular interest to all radiologists—*Blakenship vs Baptist Memorial Hospital, 168 S W (2d) 491 (Tenn, 1942)*.

Briefly the facts of the case are as follows. A radiologist was sued because of the occurrence of a third-degree reaction following irradiation of a recurrent Grade IV squamous-cell carcinoma of the uterine cervix. The position taken by the defendant—and in this he was supported by other roentgenologists—was that the treatment administered was of conventional type and the dosage within limits ordinarily accepted as safe. In treating such a cancer, however, he held that the primary consideration was not the effect on the skin but destruction of the tumor, which would

otherwise inevitably prove fatal. There had been no further recurrence in his patient following irradiation.

Another radiologist, on the other hand, testifying for the plaintiff, held that "the first consideration is never to damage the skin beyond repair." He attributed the injury to overlapping of the x-rays on the scar tissue incident to the primary operation and stated that the dose administered—2,100 r over a 14-day period—was in the danger zone.

Because of the divergence of opinion among the specialists testifying, the court took the case from the jury on the ground that a jury of laymen was not qualified to determine which method of treatment was right. Since there was no contention that the defendant did not possess the requisite learning and skill, that he made any error in diagnosis, or that he neglected the pa-

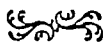
tient after the treatment, it was held that, if an excessive dose was given, it was due to an error of judgment and not of negligence

The Court of Appeals upheld the decision of the original judge in favor of the defendant, ruling that where there is a difference of opinion among physicians or surgeons with reference to the treatment to be given in a particular case, a physician will not be liable for malpractice if he follows the course of treatment advocated by a considerable number of physicians of good standing in his community. The case eventually came to the State Supreme Court, which again upheld the decision in favor of the defendant and handed down the unusual ruling that the case was never one for jury trial, since the arguments and principles involved were such that a jury could not decide.

On reviewing the original testimony in

this case, one is impressed by the eminence of the legal talent on both sides, the evidences of careful preparation, and the amount of medical testimony introduced, especially regarding the physics and biological aspects of radiation therapy. Fortunately the ultimate outcome of the action was of benefit to radiology rather than otherwise, since it brought before the public certain aspects of that specialty about which there is much misunderstanding and established a precedent which may be of future usefulness. This, however, does not minimize the serious damage that can be done to roentgenology in general and to a roentgenologist in particular by a fellow roentgenologist testifying in court on points which are primarily matters of judgment.

The abstract appearing in the J A M A is recommended reading for every radiologist.



ANNOUNCEMENTS AND BOOK REVIEWS

APPLICANTS AND DIPLOMATES AMERICAN BOARD OF RADIOLOGY

There are many Diplomates of the American Board of Radiology, as well as candidates with applications on file, whom it has been impossible to reach at the last known address. During and since the war, many radiologists have changed locations, and these changes do not appear on the records kept in the Secretary's office. It is most important that these records be accurate, and it is therefore urged that every Diplomat whose present address differs from that appearing in the new Third Edition of the "Directory of Medical Specialists" and every applicant with change of address since the filing of his application notify the Secretary immediately.

B R KIRKLIN, M D, Sec'y
Mayo Clinic, Rochester, Minn

ST LOUIS RADIOLOGICAL SOCIETY

At a recent meeting of the St. Louis Radiological Society, Dr. Wendell G. Scott was re-elected President, and Dr. Edwin C. Ernst Secretary.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Thirty second Annual Meeting of the Pennsylvania Radiological Society will be held on Friday and Saturday, May 9 and 10, at Pocono Manor Inn, Pocono Manor, Penna. Dr. Samuel G. Henderson, Chairman of the Program Committee, has announced the following speakers: Ralph D. Bacon, M D, of Erie, Penna.; Aubrey O. Hampton, M D, of Washington, D C.; C. L. Hunkel, M D, of Danville, Penna.; Reuben Alley, M D, of Pittsburgh; Paul C. Swenson, M D, and Francis F. Hart, M D, of Philadelphia; S. Gordon Castigliano, M D, of Philadelphia; Lowell L. Erf, M D, of Philadelphia; Robert F. McNattin, M D, of Harrisburg; and Ross Golden, M D, of New York City. The banquet will be held Saturday at 7:00 P M, and at that time the scientific exhibit awards will be presented.

Hotel reservations should be secured at once from Pocono Manor Inn.

THIRD AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY

The Third American Congress on Obstetrics and Gynecology will be held Sept. 8-12, in St. Louis. In addition to the general sessions for all groups making up the Congress, there will be smaller group meetings and round-table discussions on pertinent subjects, as well as concurrent sessions for nurses, hospital administrators, and public health workers. Further information may be obtained from the office of the Congress, 24 West Ohio St., Chicago 10, Ill.

DR. ROBERT KIENBOCK

It has recently been learned on good authority that Dr. Robert Kienböck, well known to many American radiologists, is still living in Vienna, having, however, suffered a stroke. If any of his colleagues here would like to remember him with parcels of food or a friendly letter, he may be reached at the following address: Dr. med. Robert Kienböck, Klumpfelberggasse 3, Vienna 17, Austria.

BOOKS AND WORLD RECOVERY

The continued need for American publications to serve as tools of physical and intellectual reconstruction abroad has been made vividly apparent by appeals from scholars in many lands. The American Book Center for War Devastated Libraries has been urged to continue meeting this need at least through 1947. The Book Center is therefore making a renewed appeal for American books and periodicals—for technical and scholarly books and periodicals in all fields and particularly for publications of the past ten years. They will especially welcome complete or incomplete files of RADIOLOGY.

Contributions should be shipped to the American Book Center, c/o The Library of Congress, Washington 25, D C., freight prepaid. Further information may be had by addressing the Center.

In Memoriam

DONALD CAMERON GORDON, M D

Donald Cameron Gordon of Scranton, Penna., died following a cerebral hemorrhage on Jan. 9, 1947, the fifty second anniversary of his birth. Dr. Gordon, prominent x-ray specialist and immediate past president of the Lackawanna County (Penna.) Medical Society, was a native of Ottawa, Canada. He fought in France with the famed "Princess Pat" regiment of the Canadian Army in World War I and entered medical school at the close of the war, receiving his degree from McGill University Faculty of Medicine in 1922. He practised in Carbondale for twelve years and was roentgenologist at the Carbondale General Hospital before going to Scranton in 1936 as an associate of the late Dr. Byron H. Jackson, one time president of the Radiological Society of North America. Dr. Gordon took over Dr. Jackson's practice upon the latter's death in 1939. In August 1942 he enlisted for active duty in the Army and returned from that service in November 1945, with the rank of lieutenant colonel. He served as chief of radiology at Camp Pickett, Va., Woodrow Wilson Hospital, Staunton, Va., and at Fort Leonard Wood, Mo. He was a diplomate of the American Board of Radiology, a member of the Radiological

Books Received

Books received are acknowledged under this head-

ing, and such notice may be regarded as recognition

of the courtesy of the sender Reviews will be pub-

lished in the interest of our readers and as space per-

mits

RADIOLOGY FOR MEDICAL STUDENTS By FRED

JENNER HODGES, M D, Professor and Chairman,

Department of Roentgenology, University of

Michigan, ISADORE LAMPE, M D, Associate Pro-

fessor, Department of Roentgenology, University

of Michigan, and JOHN FLOYD HOLT, M D, As-

sistant Professor, Department of Roentgenology,

University of Michigan A volume of 424 pages,

with 103 plates Published by The Year Book

Publishers, Inc, 304 S Dearborn St, Chicago 4,

Ill Price \$6 75

RADICAL SURGERY IN ADVANCED ABDOMINAL CAN-

CER By ALEXANDER BRUNSWIG, M D, Pro-

fessor of Surgery, University of Chicago A vol-

ume of 324 pages, with 116 illustrations and 16

tables Published by the University of Chicago

Press, Chicago, 1947 Price \$7 50

X RAY DIFFRACTION STUDIES IN BIOLOGY AND

MEDICINE By MONA SPIEGEL ADOLF, M D,

Professor of Colloid Chemistry and Head of the

Department of Colloid Chemistry, Temple Uni-

versity School of Medicine, and GEORGE C

HENNY, M S, M D, Professor of Medical Physics

and Head of the Department of Physics, Temple

University School of Medicine A volume of 215

pages, with 86 illustrations Published by Grune

& Stratton, Inc, New York, 1947 Price \$5 50

ACTIONS OF RADIATIONS ON LIVING CELLS By

D E LEA, M A, Ph D, Prophys Student of the

Royal College of Surgeons, Formerly Fellow of

Trinity College, Cambridge A volume of 402

pages, with 83 tables, 4 plates, and 61 figures

Published by Macmillan Company, New York,

1947 Price \$4 50

Book Reviews

THE LUNG By WILLIAM SNOW MILLER, Late

Emeritus Professor of Anatomy, University of

Wisconsin A volume of 222 pages, with 168 illu-

strations in black and white and in color Pub-

lished by Charles C Thomas, Springfield, Ill 2nd

edition, 1947 Price \$7 50

The second edition of this popular monograph on

the anatomy of the lung presents the subject in an

authoritative and comprehensive manner To the

superb illustrations of the earlier edition, 3 new color

plates and 16 figures in black and white have been

added In no other work is the detailed anatomy of the lung presented so attractively and so clearly

As is pointed out in the preface, no fundamental change has been made from the first edition The division into twelve chapters, devoted for the most part to structural elements of the lung, is retained Chapter 11 is an interesting historical sketch, presenting the conceptions of the earlier anatomists on the structure of the lung and tracing the development of our knowledge from the 17th century to the present day A full bibliography is appended

This monograph is a classic which deserves a place in the library of every physician and medical institution Happily the publisher has matched the excellence of the text with a format of more than usual attractiveness

X-RAYS AND RADIUM IN THE TREATMENT OF DIS-

EASES OF THE SKIN By GEORGE M MACKEE,

M D, Professor of Clinical Dermatology and

Director, Department of Dermatology (Skin and

Cancer Unit), New York Post-Graduate Medical

School and Hospital, Columbia University, and

ANTHONY C CIPOLLARO, M D, Assistant Pro-

fessor of Dermatology and Assistant Director of

Department of Dermatology (Skin and Cancer

Unit), New York Post-Graduate Medical School

and Hospital, Columbia University Contributor,

HAMILTON MONTGOMERY, M D, Associate Pro-

fessor of Dermatology, Mayo Foundation for

Medical Education and Research, Graduate

School, University of Minnesota, Rochester,

Minn A volume of 668 pages, with 321 engrav-

ings and 4 colored plates Published by Lea &

Febiger, Philadelphia, 4th edition, thoroughly re-

vised, 1946 Price \$10 00

It has been eight years since the last edition of MacKee and Cipollaro's standard text on "X-Rays and Radium in Treatment of Diseases of the Skin" appeared As might be expected, there is no outstanding change in the work, as there have been no marked changes in radiation therapy as it applies to dermatology in the interval Perhaps the chief addition to the dermatologist's armamentarium has been chemotherapy and the authors call attention to the superior results obtained with the sulfonamides and penicillin in certain skin conditions

The sequence of subjects is the same as in the third edition, except that Quimby's chapter on Spectroscopy has been omitted The chapter on The Time-Intensity Factor and Tissue Recuperation has probably undergone the greatest revamping, being much briefer than formerly The treatment of the physics of x rays and radium, and of the action of radiation on the tissues, is particularly satisfactory

To those who are familiar with this authoritative text, it needs little further in the way of recommendation It continues to merit the favorable recognition it has long received, as an outstanding work in an important field

RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates Address Howard P. Doub, M.D., The Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary-Treasurer*, Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N.Y.

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15 Mass.

AMERICAN ROENTGEN RAY SOCIETY *Secretary* Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A.M.A. *Secretary* U.V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John Day Peake, M.D., Mobile Infirmary, Mobile. Next meeting at the time and place of the Alabama State Medical Association meeting.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary* Fred Hames, M.D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary* D.R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5.

LOS ANGELES COUNTY MEDICAL ASSOCIATION RADIOLOGICAL SECTION *Secretary* Morris Horwitz, M.D., 2009 Wilshire Blvd., Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

PACIFIC ROENTGEN SOCIETY *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

SAN DIEGO ROENTGEN SOCIETY *Secretary*, R.F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY *Secretary*, Joseph Levitt, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

Colorado

DENVER RADIOLOGICAL CLUB *Secretary*, Washington C. Huyler, M.D., Mercy Hospital, 1619 Milwaukee.

kee, Denver 6. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary*, Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

Florida

FLORIDA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maxey Dell Jr., M.D., 333 West Main St., S. Gainesville.

Georgia

GEORGIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James J. Clark, M.D., 478 Peachtree St., N.E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY *Secretary*, T.J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, William DeHollander, M.D., St. John's Hospital, Springfield. Meetings quarterly by announcement.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary* Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

Indiana

INDIANA ROENTGEN SOCIETY *Secretary-Treasurer*, J.A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May.

Iowa

IOWA X-RAY CLUB *Secretary* Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer* Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer* Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V Schlosser, M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHERBROOK RADIOLOGICAL CLUB *Secretary*, Oscar O Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday, 7 30 P.M.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, Charles N Davidson, M D, 101 West Read St, Baltimore 1

Michigan

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, E R Witwer, M D, Harper Hospital, Detroit 1 Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R B MacDuff, M D, 220 Genesee Bank Building, Flint 3

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C N Borman, M D, 802 Medical Arts Bldg, Minneapolis 2 Regular meetings in the Spring and Fall

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, John W Walker, M D 306 E 12th St., Kansas City, Mo Meetings last Friday of each month

ST LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Edwin C Ernst, M D, 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month, October to May

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, O A Neely, M D, 924 Sharp Building, Lincoln Meetings third Wednesday of each month at 6 P M in either Omaha or Lincoln

New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene M D, Massachusetts Memorial Hospitals, Boston, Mass Meets monthly on third Friday at Boston Medical Library

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary-Treasurer*, Albert C Johnston, M D, Elliot Community Hospital, Keene Meetings quarterly in Concord

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, W H Seward, M D, Orange Memorial Hospital,

Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC *Secretary*, William J Francis, M D, East Rockaway, L I

BROOKLYN ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Abraham H Levy, M D, 1354 Carroll St, Bklyn 13 Meets fourth Tuesday of every month, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C Gian, M D, 610 Niagara St, Buffalo 1 Meetings second Monday evening each month, October to May, inclusive

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary-Treasurer*, Dwight V Needham, M D, 608 E Genesee St, Syracuse 10 Meetings in January, May, and October

LONG ISLAND RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY *Secretary*, Wm Snow, M D, 941 Park Ave, New York, 28

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary*, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital, third Monday September through May

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary-Treasurer*, James E Hemphill, M D, Professional Bldg, Charlotte 2 Meets in May and October

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M D, 1338 Second St, N, Fargo

Ohio

OHIO RADIOLOGICAL SOCIETY *Secretary*, Henry Snow, M D, 1061 Reibold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Hugh A Baldwin, M D, 347 E State St, Columbus

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, George L Sackett, M D, 10515 Carnegie Ave, Cleveland 6 Meetings at 6 30 P M on fourth Monday, October to April, inclusive.

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists) *Secretary-Treasurer*, Samuel Brown M D, 707 Race St, Cincinnati 2 Meets third Tuesday of each month

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Peter M Russo, M D, 230 Osler Building, Oklahoma City Meetings three times a year

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary*
Treasurer James M Converse, M D, 416 Pine
St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*,
Calvin L Stewart, M D, Jefferson Hospital,
Philadelphia 7 Meets first Thursday of each
month at 8 00 P M, from October to May in
Thomson Hall College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*,
Lester M J Freedman, M D, 415 Highland Bldg,
Pittsburgh 6 Meets second Wednesday of each
month at 6 30 P M October to May, inclusive

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-
Treasurer*, A M Popma, M D, 230 N First St.,
Boise, Idaho

South Carolina

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*,
Robert B Taft, M D, 103 Rutledge Ave, Charles-
ton 16

Tennessee

MEMPHIS ROENTGEN CLUB Meetings second Tuesday
of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treas-
urer*, J Marsh Frère, M D, 707 Walnut St Chat-
tanooga Meets annually with State Medical
Society in April

Texas

DALLAS FORT WORTH ROENTGEN STUDY CLUB *Sec-
retary* X R Hyde, M D Medical Arts Bldg,
Fort Worth 2 Meetings on third Monday of each
month, in Dallas in the odd months and in Fort
Worth in the even months

TEXAS RADIOLOGICAL SOCIETY *Secretary Treasurer*
R P O'Bannon, M D, 850 Fifth Ave Fort Worth
4

Utah

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treas-
urer*, M Lowry Allen, M D Judge Bldg, Salt
Lake City 1 Meets third Wednesday, January,
March, May September, November

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE
Secretary Henry H Lerner M D Meets first and
third Thursdays September to June, inclusive
at Salt Lake County General Hospital

Virginia

VIRGINIA RADIOLOGICAL SOCIETY *Secretary* E Latan
Flanagan, M D, 215 Medical Arts Bldg Rich-
mond 19

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secre-
tary Treasurer*, Frederic E Templeton, M D, 324
Cobb Bldg, Seattle 1 Meetings fourth Monday,
October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary
Treasurer*, C A H Fortier, M D, 231 W Wiscon-
sin Ave, Milwaukee 3 Meets monthly on second
Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MED-
ICAL SOCIETY *Secretary*, S R Beatty, M D 185
Hazel St, Oshkosh Two-day meeting in May
and one day at annual meeting of State Medical
Society in September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Meets first and third Thursdays 4 to 5 P M, Sep-
tember to May, inclusive, Room 301, Service Mem-
orial Institute, 426 N Charter St, Madison 6

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary
Secretary-Treasurer*, E M Crawford, M D, 2100
Marlowe Ave Montreal 28 Quebec. Meetings
in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE
ET DE RADIOLOGIE MÉDICALES. *General Secretary*
Origène Dufresne M D Institut du Radium,
Montreal Meets on third Saturday of each
month

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA.
Offices in Hospital Mercedes, Havana Meets
monthly

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary Dr Dionisio Pérez Cosío,
Marsella 11 México D F Meetings first Monday
of each month



ABSTRACTS OF CURRENT LITERATURE

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

A Method of Encephalography E Graeme Robertson *Surgery* 19 810-824, June 1946

A method is described whereby, through posturing the neck, gas can be delivered with certainty from the lumbar puncture site into any portion of the cerebral subarachnoid space, or into the ventricles of the brain. By the use of this method an accurate analysis of the influence of posture on the distribution of air within the cerebrum has been made. The progression of gas through the subarachnoid and ventricular spaces depends solely on the physical laws of hydrodynamics, and is independent of vascular pulsation, since the same effects are obtained in the cadaver. The paths that will be taken by gas injected in the lumbar region are given for all possible positions, including (1) supine, with head extended and flexed, (2) prone, with head extended and flexed, and (3) upright, with head extended and flexed to varying degrees. A clear analysis is made of the reasons why the various routes are taken and the proper views to be made at each stage of filling are indicated.

Briefly, the technic is as follows. After suitable preparation, the patient is supported upright before apparatus that enables postero-anterior and lateral skull films to be made without moving the head. Two lumbar puncture needles are inserted in adjacent lumbar interspaces. Oxygen is introduced through the upper needle, while fluid is allowed to escape through the lower. Constant normal pressure is maintained, as indicated by a manometer attached to the lower needle.

From full flexion the head is gradually extended until the cisterna magna, fourth ventricle, aqueduct, third, and lateral ventricles are filled in turn. Posturing for filling other portions of the cerebrospinal fluid spaces is described. Films are made in successive stages of filling and the position of the head is changed so as to direct the filling of whatever cavities it is desired to visualize. When the ventricles are satisfactorily filled the patient is placed in the recumbent position and the following views are made: anteroposterior, postero-anterior, and both stereoscopic laterals. Additional views which may be taken, according to the region suspected of harboring pathological processes are the lateral with the face up and anteroposterior with the head in lateral decubitus. These films are then studied before the patient is returned to his room, and special views are made as indicated.

The entire procedure requires about sixty minutes. In 500 examinations by this method including over sixty neoplasms, no serious complications were observed. Some of the neoplasms were in the cerebral hemispheres, some were suprasellar, and some were in the posterior fossa. However, when there is much elevation of the lumbar cerebrospinal fluid pressure or with indications of incisural or foraminal herniation, ventriculography is done.

Causes of failures are discussed with corrective maneuvers for each. A detailed discussion of posturing to investigate the posterior fossa with excellent diagrams, is presented. For a thorough description of the entire procedure of insufflation of air into the cerebrospinal fluid spaces through lumbar injection with the patient upright, the reader is referred to the original article.

JOHN E. WHITELEATHER, M.D.

The Use of Laminagraphy with Encephalography in the Diagnosis of Midline and Subtentorial Brain Tumors Bernard S. Epstein and Leo M. Davidoff *Am J Roentgenol* 55 675-688, June 1946

Visualization of the 3d and 4th ventricles, the aqueduct of Sylvius, the basilar cisterns, and the cerebellum is particularly important in the diagnosis of midline and subtentorial brain tumors. These structures are frequently difficult to demonstrate by pneumoencephalography, and particularly by ventriculography. They are often obscured by the paranasal sinuses, the mastoid cells, petrous pyramids, and air in the convolutional sulci. Much more frequent visualization of the midline structures may be obtained by adding body-section roentgenography to the routine pneumoencephalographic procedures.

With the authors' technic, the standard pneumoencephalographic exposures are made and the wet films are examined. Following this the patient is transferred to the laminagraphic room and placed in the prone position, the head being positioned as for a lateral roentgenogram. A lateral laminagram is made through the sagittal plane in the midline and either 0.5 or 1 cm above the midline, with the head in right and left lateral positions. Other views are obtained as required for the individual patient. Results with laminagraphy in the postero-anterior and anteroposterior positions have not warranted their routine use.

The roentgenographic anatomy of the midline structures is reviewed.

The authors have made laminagrams as a part of the pneumoencephalographic examination in approximately 100 patients. Fifteen of these had tumors encroaching on midline structures. Review of these cases in addition to 30 control cases which did not have subtentorial or midline tumors showed visualization of the midline structures by the laminagrams to be consistently better than in the routine pneumoencephalograms. Six case reports illustrating the authors' observations are included.

H. H. WRIGHT, M.D.

Subdural Pneumography Campbell Howard *Am J Roentgenol* 55 710-716, June 1946

The author describes a technic for subdural pneumography and discusses the anatomical features which are revealed by this procedure. By this method the normal and abnormal attachments between the cerebral cortex and dura not visualized with the usual subarachnoid air injection are demonstrable.

The method of introduction of air into the subdural space is described. The roentgenograms are made at a 6-foot tube film distance with the use of a small cone without a grid. Five anteroposterior and three lateral roentgenograms are made, with the head in varying degrees of flexion and extension. A second series of films is taken twenty-four hours later. The procedure is less distressing to the patient than encephalography, but headache and nausea may be produced. The patient is prepared with 9 to 12 gr. of phenobarbital in divided doses, beginning four hours before the operation, the last dose being given one hour before it. Sudden changes in the position of the head may cause considerable distress. The discomfort described by the patients closely resembles the headache, nausea, and vomiting attending migraine.

Normally the subdural space is a potential one only with no communication between it and the subarachnoid space. After the subdural introduction of air the cortex falls away from the dura over the vault, leaving a space of variable depth. There are no normal attachments between the arachnoid and the dura in this region except adjacent to the sagittal sinus. There is a wide variation in size and extent of these attachments. Arachnoidal granulations may extend into the dura, producing erosions of the inner table of the skull and fixing the cortex to the skull and dura. The corticodural attachment may be considerably widened in the presence of large arachnoidal granulations.

When air enters the subdural space during encephalographic examination it probably indicates a tear in the arachnoid or an arachnoidal fistula. In some instances there is greater separation of cerebral cortex and cranial vault on one side than on the other. In these instances, if the ventricles are air-filled downward displacement of the ventricle is demonstrated on the side of greatest corticodural separation. This is not noted without air in the subdural space. In subdural pneumography this corticodural separation occurs with air at atmospheric pressure. These findings suggest that the subdural space maintains a negative pressure and that it is this negative pressure rather than the corticodural attachment which determines the normal relationship between the cortex and the cranial vault.

H. H. WRIGHT, M.D.

Discussion on Cortical Atrophy Harvey Jackson and John J. Fleminger. *Proc. Roy. Soc. Med.* 39: 423-430, May 1946.

Jackson discusses the etiology of cortical atrophy mentioning as possible causes trauma (including that incident to repeated convulsive therapy), injury due to intensive x-ray therapy for cerebral tumors and infections and vascular disturbances producing localized areas of encephalitis. He states that the differentiation between tumor and atrophy may be reached clinically but as a basis of treatment confirmatory evidence should be obtained by encephalography or ventriculography. Gross defects in the radiographic appearances are easy enough to interpret but just how much alteration in a film is essential to confirm the presence of atrophy is uncertain. It is Jackson's impression that accumulations of air over the parietal cortex are evidence of abnormality especially if these are demonstrated with the patient in the horizontal posture. The relative size of the ventricular system and the skull are considered, and Evans (*Arch. Neurol. & Psychiat.* 47: 931, 1942; *Abst. in Radiology* 40: 208, 1943) is quoted on this point. Judging from his figures the normal ratio between the transverse diameter of the anterior horns and internal diameter of the skull is not less than 1/3.

From 71 cases of cortical atrophy Fleminger selected for study 12 cases, presenting clinically as cerebral tumors and probably allied in pathology to the presenile dementias, but differing from these in the absence of dementia. Clinical features included epilepsy of all varieties with transient attacks of paresis of the limbs, dysphasia, headaches and attacks of dizziness.

Plain films showed no significant abnormality. The characteristic features discovered on encephalography or ventriculography were dilatation of the ventricles either bilaterally or unilaterally without any shift in the ventricular system, and, more striking, an increase in the convoluted markings in the subarachnoid space,

revealing widened sulci. Subdural puddles of air at the frontal and occipital poles and down the side of the falx were frequently seen and were sometimes demonstrable in the temporal region, in ventriculograms. In this connection mention is made of the increase in depth of the subdural space and the lax, sometimes wrinkled dura found when the burr hole for ventriculography has been made. These were often the first indications that one was not dealing with a space-occupying lesion. One important fact is that, although the physical signs and the symptoms may point to only a local cortical lesion, and in fact there may only be a unilateral ventricular dilatation, this is not always the case, and frequently the area of atrophy as demonstrated by air studies is seen to extend over a wide distribution and often to the opposite hemisphere.

When the roentgen findings were not characteristic operation was helpful in making a diagnosis, and pathological examination of tissues removed left no doubt as to the condition though it gave no accurate classification of the nature of the changes.

[A detailed analysis of the roentgen diagnosis of cortical atrophy is not given in this article, but from the reproductions it is obvious that the amount of air in the subarachnoid space is greater than the 1 to 3 mm. considered normal (see, *The Head and Neck in Roentgen Diagnosis* by Pancoast *et al.* p. 744).]

SYDNEY F. THOMAS, M.D.

Coarctation of the Walls of the Lateral Angles of the Lateral Cerebral Ventricles Leo M. Davidoff. *J. Neurosurg.* 3: 250-256, May 1946.

Asymmetry of the two lateral ventricles of the brain, observed in certain clinical cases in which pneumoencephalography was done for various reasons, such as epilepsy or post-traumatic headache, was investigated. This asymmetry consists of a normal looking 'butterfly wing' pattern of the ventricle on one side and a truncated one on the other. Since the normal appearing ventricle was also of normal size the asymmetry obviously could not be explained on the basis of a unilateral dilatation and the obvious conclusion had to be reached that the smaller ventricle was the anomalous one. The possible causes for this appearance were believed to be: (1) inadequate filling of the ventricle with gas; (2) a filling defect produced by a tumor; (3) adhesions resulting from a healed inflammatory process; (4) a congenital anomaly. The first two possibilities were ruled out by clinical and roentgenologic studies and the third appeared highly improbable in view of the case histories. That the fourth explanation was the correct one was shown in a study of 64 brains taken routinely from patients dying from causes chiefly other than neurological. Among the 64 specimens 8 showed asymmetry of the ventricles on postmortem ventriculograms. 10, deviation of a similar nature on coronal section. 4 positive roentgenographic changes and corresponding pathological changes. The asymmetry was found to correspond to an area of coarctation of the ventricular walls usually at or near the extreme lateral angle of one ventricle. This is believed to take place during the developmental period of the brain.

Reversibility of Cerebral Ventricular Dilatation. Henry A. Shenkin and Charles R. Perryman. *J. Neurosurg.* 3: 234-238, May 1946.

Three cases of internal hydrocephalus caused by an obstructing lesion in either the third or fourth ventricle

were studied by ventriculography before and ventriculoencephalography after relief of the obstruction. In each patient the lateral ventricles were smaller after operation showing in the authors' opinion, that ventricular size in many instances is reversible if the dilatation of the ventricles is due to an obstructive lesion and the obstruction has not been present too long. Roentgenograms are reproduced.

Extensive Erosion of the Base of the Skull from a Leptomenigeal Cyst. Report of a Case. Arthur B. Soule, Jr., and Benjamin B. Whitcomb. Arch Neurol & Psychiat 55 382-387 April 1946.

Leptomenigeal cysts are collections of clear or xanthochromic fluid located within the subarachnoid or subdural space or between the layers of dura. They usually occur following severe trauma to the skull with damage to the leptomeninges. Clinical evidence of these cystic lesions may not be manifest for months or years after injury. The usual roentgenologic findings consist of thinning and bulging of bone immediately adjacent to the lesion. Rarely there is complete erosion of both tables, with bulging of the cyst into pericranial soft tissues. In either event the changes are most often seen in the parietal, frontal, and occipital regions.

Soule and Whitcomb report the case of a 28-year-old soldier in whom a leptomenigeal cyst was discovered one and one half years following a mild cerebral concussion resulting from a bomb explosion. The outstanding feature of the case was the unusual location in the floor of the middle cranial fossa. Erosion of bone, best seen in the verticosubmental view and in the oblique projections of the orbits, was so extensive that the entire cyst appeared to be completely outside the cranial cavity. The differential diagnosis and successful surgical treatment of the lesion are described.

JOHN F. HOLT, M.D.
(University of Michigan)

Some Observations on the Morphologic Evolution of the Osseous Changes in Paget's Disease with Particular Reference to Changes in the Skull of the Type of So-Called "Osteoporosis circumscripta." Mario Paoletti. Arch di radiol (Naples) 18 237-248, November-December 1942.

The author presents roentgenograms (in 12 full page plates) of two cases of Paget's disease which he followed for four to six years. Both patients presented the typical changes of osteoporosis circumscripta of Schüller in the skull and both had other lesions typical of Paget's disease in several bones.

E. T. LEDDY, M.D.

Linear Fracture of the Skull Across the Venous Sinuses. Arthur D. Ecker. New York State J. Med 46 1120-1121, May 15 1946.

Linear fractures or diastatic injuries to sutures of the skull may cross the major venous sinuses and produce obstruction of venous outflow even though there is no bone depression. The unpaired venous outflow may, in turn, produce headache, mental confusion, and papilledema. Comparative Queckenstedt tests on both sides demonstrate the venous impairment. Queckenstedt tests are not conclusive but when considered in connection with the clinical course and the location of the injury are very helpful. Prompt recognition of the condition and conservative management with maintenance of upright posture may prevent unnecessary surgical

exploration and ventriculography. The latter procedure is difficult, since the ventricles tend to be small and the injected air is often forced out of them into the subarachnoid space.

Two cases are briefly reported. In each instance the patient was kept up and about, and in each there was fairly prompt subsidence of papilledema and full recovery.

ROBERT C. PENDERGRASS, M.D.

Neurofibromatosis with Defect in Wall of Orbit. Report of Five Cases. William T. Peyton and Donald R. Simmons. Arch Neurol & Psychiat 55 248-265, March 1946.

Neurofibromatosis is a congenital defect of hereditary nature which was originally described by von Recklinghausen as being characterized by cutaneous tumors and pigmentation (*cafe au lait* spots). It has since been shown that the disease may manifest itself in many other ways, and of the changes which have been described, those involving the osseous system are perhaps the most remarkable. The long list of osseous abnormalities in this condition includes such defects as scoliosis, kyphosis, overgrowth and undergrowth of individual bones, central and peripheral cyst-like defects, and pseudarthroses. In the skull one may find bulging of circumscribed areas, peculiar vascular designs, temporal or parietal bossing, localized erosion and atrophy of the vault, various types of gross asymmetry and other defects.

To the relatively large group of patients with skull lesions reported as occurring in conjunction with neurofibromatosis, Peyton and Simmons add 5 more, each with a defect in the wall of an orbit permitting free communication between that structure and the intracranial cavity. Although pulsating exophthalmos was present in all 5 cases, in at least 2 instances a retrobulbar neurofibroma was not present, the orbital defect existing as a related but separate anomaly. In such circumstances the exophthalmos obviously was due to encroachment on the orbit by the brain and meninges.

Roentgenographic examination will serve to identify the defect in the orbit, but it may be overlooked if films are not carefully scrutinized. Orbital enlargement with increase in density of that structure, absence of the normal markings in the orbital roof, and deformities of the sella turcica are some of the abnormalities which may be observed. The roentgenologist should always consider the possibility of neurofibromatosis as an etiological factor when orbital defects are encountered.

JOHN F. HOLT, M.D.
(University of Michigan)

Ethmoido-Sphenoidal Hypertrophy with Endocranial Protrusion. Dino Agati. Radiol med (Milan) 32 151-154, May 1946.

Agati reports two cases of marked hypertrophy of the sphenoid sinus. Both patients were adults, with visual symptoms beginning about a year before medical help was sought. Ophthalmic examination revealed bilateral temporal hemianopsia and the patients were suspected of having sellar tumors. For this reason they were sent to the radiologist who found normal sellar contours with marked protrusion of the anterior portion of the roof of the sphenoid sinus into the cranial cavity. Agati believes that this protrusion caused enough impingement on the optic nerves to explain the visual syndrome.

CESARE GIANTURCO, M.D.

THE CHEST

Roentgenographic Scanning of the Chest. Sherman W Atwell *Dis of Chest* 12 222-227, May-June 1946

Because the conventional chest film may be inaccurate and misleading and a simple stereoroentgenogram is not always entirely comprehensive, the author has devised a method whereby two stereoroentgenographic examinations are made of a given part, in two positions, on one set of films. This is accomplished by the use of lead strips to block half the film either vertically or horizontally, depending upon whether one wishes to study the right or left or the upper or lower half of the thorax. In especially intricate areas, such as the subthoracoplasty lung, information can frequently be gained by using both blocks and taking four "scanning" views. With this method, one avoids the necessity of changing films for a comparison study, with the lag in memory which makes such comparison so uncertain.

HENRY K. TAYLOR, M D

The Middle Lobe of the Left Lung. Aldo Piergrosi *Radiol med (Milan)* 32 154-165, May 1946

Piergrosi describes the radiological appearance of the middle lobe of the left lung. This lobe corresponds very closely to the right middle lobe in its anatomical and radiological characteristics. Its recognition is important because of the surgical implications.

CESARE GIANTURCO, M D

The Normal Lung Markings and Their Variations with Age. Giovanni Gardella *Radiol med (Milan)* 32 173-192, June 1946

Gardella states that the most important changes in the pulmonary markings occur in infancy and in old age. These changes consist of a progressive increase of aerated tissue separating vessels and bronchi. During infancy and adult life this aerated tissue is normal pulmonary tissue. In old age a gradual destruction of the alveolar septa leads to a varying degree of emphysema.

CESARE GIANTURCO, M D

On Retrocardiac Pulmo-Pleural Demarcation Lines and Their Diagnostic Significance. L Billing *Acta radiol* 27 257-263 May 6, 1946 (In English)

The importance of studying the pneumo-pleural lines on chest roentgenograms in order to detect slight densities which may indicate pathologic pulmonary or pleural processes has been stressed by Edling (*Acta radiol* 23 595 1942 *Abst in Radiology* 45 200 1945). A pleural process as a rule displaces or deletes a considerable portion of the lung contour. In the present paper the author confines his discussion to local breaks in contour which have proved an indirect sign of parenchymatous induration. This sign is particularly valuable in diagnosing retrocardiac processes as a defect in the aortic contour is fairly often the only unequivocal evidence of some slight lung process which cannot be projected free whatever the direction of the x-ray beam. Such defects are not always of pathologic significance, however, as they may be due to some anatomical variation in the posterior mediastinum. The author gives the physical and anatomic basis for these observations.

To study details of retrocardiac parts of the lungs roentgenograms should be taken with considerably heavier exposure than the usual frontal views (sagittal

radiation) and with the use of a grid. Three demarcation lines have been found useful: the border line between the diaphragm and the lung in the postero-anterior and lateral views, the retrocardiac lines in the frontal view, and the borderline between the wall of the thorax and the lung in the lateral view. Only the retrocardiac pulmo-pleural lines on the left side are discussed here.

Silicosis, the Most Important of the Pneumoconoses. Norbert Enzer *Occupational Med.* 1 425-442, May 1946

The term 'pneumoconiosis' embraces all forms of pulmonary reactions to the inhalation of inorganic dusts. Silicosis is the most important of these but is rarely pure or uncomplicated, for there is often an adulterating dust affecting the character of the lesions in various ways and degrees. The rate at which the disorder will develop depends on the intensity of dosage, and this involves consideration not only of the total amount of dust inhaled but of the length of time over which it is inhaled and its chemical and physical structure. The more finely divided the silica the more serious its effect.

The essential anatomic features of the silicotic lung may be summarized as follows: (1) a nodular fibrosis scattered throughout both lungs, associated with a similar formation in the corresponding lymph nodes, (2) coal or dust pigment in the areas of fibrosis in the lungs, lymph nodes and pleura, (3) pigmentation and some fibrous thickening of the pleura, (4) microscopic emphysema in the region of the nodule only, widely disseminated and uniform emphysema, and irregular or bullous emphysema, (5) increased number of nodules, with a tendency to conglomeration, (6) progressive enlargement and induration of the hilar lymph nodes, often to the point of massive fixation, (7) evidence of bronchitis and bronchiolitis, (8) strain on the right side of the heart, indicated by hypertrophy of the right ventricle and dilatation of the right chambers, (9) tuberculosis in any of its forms.

With an understanding of the anatomic pattern of silicosis one may more accurately interpret the roentgenologic manifestations. In most cases the simple roentgenogram is adequate for diagnosis. But for the detection of emphysema, mediastinal nodes and effects on the heart highly technical and refined methods of examination are necessary, calling for the most highly skilled and trained radiologists. Plainography and angiocardiology have not been used up to now as often as would be desirable, thus many of the effects of silicosis are not detected and understanding and explanation of the symptoms are not achieved. When these special procedures are applied in more cases, there will be a closer approximation of the clinical behavior, physiologic disturbance and pathologic conditions.

Coexistent Pulmonary Asbestosis and Sarcoidosis. John H Skavlem and Robert J Rutterhoff *Am J Path* 22 493-517 May 1946

Sarcoidosis and pulmonary asbestosis present many clinical and roentgenographic similarities and are alike also in their more frequent fatal complications, namely, pulmonary tuberculosis and cardiopulmonary insufficiency. A unique case of coexisting asbestosis and sarcoidosis is reported, the only example of either condition in a series of 1870 necropsies at Dunham Hospital (Cincinnati).

The patient, a 42-year old male had worked in an

asbestos plant for twenty-five years. Previous to December 1943 he noticed that slight activity produced shortness of breath, though he was able to lie flat in bed without respiratory difficulty. There was no history of cough, hemoptysis, or cardiac embarrassment. The patient lost 22 pounds in weight from December 1943 to March 1944 at which time he presented himself for medical care. The anteroposterior diameter of the chest was increased. Respiratory excursions were equal but decreased. The percussion note was resonant, and auscultation revealed fine râles over the bases of the lungs posteriorly. There was no evidence of cardiac enlargement, irregularity, or decompensation. A roentgenogram of the chest revealed moderate enlargement of the hilar shadows bilaterally. One calcified area was present in each hilum, with numerous small nodular densities scattered through both lung fields, especially throughout the lower lobes. There was some confluence of the densities in the left lower lobe. Emphysema was present. The sedimentation rate was 26 mm. Vital capacity was 51 per cent of normal. Tuberculin tests were not done.

The patient was seen at regular intervals, and his only complaint was increasingly severe exertional dyspnea. A roentgenogram of the chest four months after the original film revealed nothing further. Dyspnea became progressively more severe so that eventually, even at bed rest, there was extreme air hunger. At no time was there evidence of cardiac failure. Death occurred approximately eleven months after the onset of symptoms, apparently from respiratory failure. The primary findings at autopsy were a moderate pulmonary asbestosis and extensive sarcoidosis of pulmonary and tracheobronchial lymph nodes.

Clinically, in view of the significant history of exposure to asbestos, the possibility of sarcoidosis was never entertained. In retrospect, the rapidly progressive disabling dyspnea unaccompanied by evidence of enlargement of the right heart or cardiac failure, should have aroused suspicion that there was a concomitant pulmonary lesion. Asbestosis alone is not usually accompanied by such profound, rapidly developing, respiratory embarrassment. It would seem that a clinical diagnosis of coexistent asbestosis and sarcoidosis would be justified only by biopsy of a lymph node or a skin lesion to demonstrate sarcoid lesions and the discovery of asbestos fibers in the sputum, with a history of adequate exposure to asbestos and roentgen evidence of diffuse pulmonary fibrosis.

Latent Silicosis and Tuberculosis. Howard Dayman. *Am Rev Tuberc* 53: 554-559, June 1946.

Clinical and experimental studies have shown that silicosis renders the patient more susceptible to tuberculosis, but the degree of silicosis required to bring about this alteration in resistance is not clearly defined. Four case reports are presented to show that silicosis of such a degree as not to be clearly demonstrable on roentgenograms of good technical quality may exert a harmful effect on the resistance to tuberculosis. In none of the patients was typical silicotic nodulation present at first. In three, the periods of exposure to silica dust were relatively short—seven, fourteen, and five years respectively. The development of nodulation late in the course of the disease appeared to be due to the fact that tuberculosis accelerates the growth and enhances the size of the silicotic nodule. The development of tuberculous disease about the nodule also con-

tributes to a more conspicuous shadow on the roentgenogram.
L. W. PAUL, M.D.

Importance of Systematic Radiophotography in Case Finding of Pulmonary Tuberculosis. O. M. Mistal. *Schweiz med Wchnschr* 76: 405-410, May 11, 1946.

The author reports the results of a photofluorographic survey in Switzerland covering 10,026 cases. He divides his material into two groups, 4,840 adults and 5,186 children. In the first group there were 3,820 normal chests, 719 minor changes in morphology, 267 cases of controllable disease, of which 67 were pulmonary tuberculosis, 34 cases of serious disease, of which 25 were pulmonary tuberculosis. In the second group 4,634 were normal, 215 showed minor alterations, 332 showed controllable disease (118 cases of pulmonary tuberculosis), and 5 showed serious disease (2 cases of pulmonary tuberculosis). The relatively small percentage of serious tuberculosis in the younger group is believed to be due to the careful examination of school children which is generally practised in Switzerland. The author feels that the use of photofluorography is an important adjunct to the control of tuberculosis, particularly in those countries which have undergone the hardships of war.
LEWIS G. JACOBS, M.D.

A Mass Chest X-Ray Survey in Philadelphia War Industries. William F. Elkin, Mary A. Irwin and Charles Kurtzhals. *Am Rev Tuberc* 53: 560-565, June 1946.

The present report details the results of a mass chest x-ray survey of 71,767 civilians employed in three war industries located in the Philadelphia area. A 4 X 5-inch photofluorographic unit was employed. The diagnosis in positive cases was completed by a thorough physical examination, sputum studies and a 14 X 17-inch roentgenogram. As a result of the survey, 1,633 persons (2.3 per cent) were classified as having x-ray evidence of reinfection tuberculosis. It was found that the incidence of tuberculosis increases with age, the percentage rising consistently from 0.3 per cent in the fifteen to nineteen-year age group to 9.4 per cent in the age group sixty-five and over. This holds true regardless of sex and race (white or colored). Cardiovascular abnormalities found incidental to the search for tuberculosis numbered 1,409, an incidence of 2.0 per cent.
L. W. PAUL, M.D.

Pneumonia in the Aged. Analysis of One Hundred Sixty-Six Cases of Its Occurrence in Patients Sixty Years Old and Over. Frederic D. Zeman and Kaufman Wallach. *Arch Int. Med* 77: 678-699, June 1946.

One hundred and sixty-six cases of pneumonia in men and women sixty years of age and older have been studied. In 143 of these (86 per cent) the clinical diagnosis of pneumonia was confirmed by roentgenography, fluoroscopy, or necropsy. Sixty-five cases were due to various types of pneumococci. Thirty-three cases (20 per cent) were fatal. One hundred and forty patients received sulfonamide drugs, 9 received penicillin, and 2 were treated with both drugs; 4 patients were given type-specific serum in addition to sulfonamide drugs. [These figures are taken from the text of the paper. They differ slightly from those given in the authors' summary.]

Among the conditions most frequently associated with pneumonia in the aged are cardiovascular, pulmonary, nutritional, and cerebral diseases.

THE CHEST

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Transient Pulmonary Radiologic Opacities and the Syndrome of Löffler Cicero Michelangelo Arch di radiol (Naples) 18 129-142, July-October 1942

The author discusses the clinical and roentgenologic aspects of Löffler's syndrome and adds the observations of four physicians who had had it themselves

E T LEBBY, M D

Pulmonary Disease Secondary to Cardiospasm, with Acid Fast Bacilli in the Sputum (Case Report) Emil Rothstein and H B Pirkle Dis of Chest 12 232-237, May-June 1946

A white woman, aged 31, was admitted to a sanatorium with a diagnosis of bilateral tuberculous pneumonia. Sputum examination was repeatedly negative except for the discovery of acid-fast bacilli in three of eight concentrate specimens, it was subsequently decided that these were not tubercle bacilli. The roentgenogram showed "coarsely mottled conglomerate infiltration with multiple cavitation" in the upper half and moderately coarsely mottled infiltration in the lower half of the right lung. In the left lung there was a "conglomerate coarse infiltration, with multiple small cavitation, in the central lung field." The acute phase subsided and the sputum thereafter was persistently negative in spite of a profuse purulent expectoration. Further study revealed cardiospasm and a dilated esophagus. A review of the original roentgenogram showed a widened mediastinal shadow with a fluid level which had originally been overlooked. The acute pulmonary findings subsequently regressed and were replaced by a chronic fibrosing process.

The author believes that the roentgen picture obtained in this case may be characteristic as exactly similar pictures have been described in two other cases (Warring and Ralance J Lab & Clin Med 28 1591 1943 Baldwin Am Rev Tuberc 45 756, 1942)

HENRY K TAYLOR, M D

Pulmonary Oil Embolism. Maria E Grossmann Brit J Radiol 19 178-180, May 1946

Oil embolism in the lungs following uterosalpingography is fortunately rare. Several cases from this cause as well as other procedures involving the use of iodized oil have been reported. Two additional cases are presented here. In each the salpingogram was made to determine patency of the tubes. In one case the embolism occurred immediately after the injection and in the other two days later. In both cases the oil was demonstrable on films of the chest. Both patients recovered.

SYDNEY J HAWLEY M D

Pleural Transudates Unusual Roentgenological Configuration Associated with Congestive Failure. Aaron E Parsonnet Emanuel Klosk and Arthur Bernstein Am Rev Tuberc 53 599-607, June 1946

Three cases are reported in which fluid collections developing in the pleural cavities as a result of cardiac failure did not show the usual roentgenographic signs of pleural effusion. In each instance the upper margin of the fluid shadow was sharply convex simulating an elevated diaphragm. In two of the cases the induction of pneumoperitoneum revealed that the abnormal shadows were above the diaphragm and fluid was aspirated. In the third case autopsy showed the true nature of the condition. In addition to roentgenograms taken in the supine and lateral decubitus positions to demonstrate

shifting of the fluid, as recommended by Rigler, the authors suggest that pneumoperitoneum may also be a valuable diagnostic aid in cases of this type.

L W PAUL, M D

Mediastinal Tumors Report of Cases Treated at Army Thoracic Surgery Centers in the United States Brian Blades Ann Surg 123 749-784, May 1946

At the time of this report, 109 patients had been operated upon for mediastinal tumors at Army Thoracic Surgery Centers in the United States. This number includes only cases in which either the clinical manifestations of an intrathoracic neoplasm or discovery of a mass in the mediastinum by roentgen examination after entrance on active duty resulted in surgical exploration. There were 94 benign and 15 malignant tumors in the group.

Bronchiogenic cyst, considered to be a relatively rare growth, was encountered 23 times. An accurate pre-operative diagnosis of this tumor depends almost entirely on roentgen examination. On the frontal projection, the mass may resemble a teratoid tumor or a primary nerve tumor. A lateral film is of more diagnostic significance, since the extreme posterior position common to most primary nerve tumors will not be duplicated, while the shadow of the mass on the lateral view is not usually so distinct as in the case of teratoid tumors. Fluoroscopy is also of importance in establishing the diagnosis, since most bronchiogenic cysts are attached to the trachea; the mass will move with the act of swallowing. Roentgenograms made by the Potter-Bucky technic, visualization of the esophagus with barium sulfate to determine its relationship to the mass, and delineation of the bronchial tree with radiopaque oil are sometimes useful. Unless the age and general condition of the patient preclude a major operation, the proper treatment of bronchiogenic cysts is surgical extirpation.

There were 20 *teratoid tumors* in the series. In 14 cases the tumor was benign. Far advanced malignant changes were evident in 6. Teratoid tumors usually produce sharp and obvious roentgenographic shadows which are easily detected. Unless teeth or bone are visible on the films however, the exact diagnosis cannot be made roentgenologically. The characteristic anterior position of the mass is suggestive but not conclusive. The relatively low incidence of teratoid tumors in military personnel is explained by the discovery of the tumor on the pre-induction roentgenograms of the chest. The treatment is surgical extirpation. Roentgen therapy is of no value in treatment of benign teratoid tumors and is probably equally ineffectual when malignant changes have occurred. The danger of malignant change is considerable.

Twenty nine *benign neurogenic tumors* of the mediastinum including neurofibromas, ganglioneuromas, sympathicoblastomas etc., have been removed successfully. One patient with a neurogenic sarcoma was operated upon but invasion of surrounding structures precluded removal. The roentgen shadow of a primary nerve tumor may be round, spherical, or lobulated. The typical extreme posterior position of the tumor is characteristic. Roentgen examination should include studies of the spine for bone erosion and evidence of so-called dumb-bell tumor. The shadow on the roentgenogram is usually sharply circumscribed, both in frontal and lateral views. The correct treatment is surgical excision before the tumor becomes malignant.

Because of the obstacles to accurate physical diagnosis, roentgenography is of special value in these elderly patients, but even the roentgenogram may be misleading. In the differential diagnosis, the following diseases must be seriously considered and ruled out: (1) coronary thrombosis with myocardial infarct and early pulmonary edema, (2) congestive heart failure with or without pulmonary infarct, (3) pulmonary embolism arising often from a silent phlebotrombosis of the lower extremities, (4) pulmonary abscess, (5) bronchostenosis either from foreign bodies or from neoplasms, (6) pulmonary atelectasis of either the lobar (massive collapse) or lobular type, (7) pulmonary neoplasms, both primary and metastatic, (8) metastatic septic foci, (9) pulmonary tuberculosis, (10) bronchiectasis and (11) the chronic lipid pneumonias. The principal complications are empyema meningitis and endocarditis.

The mortality in pneumonia in the aged has been dramatically reduced by recent advances in therapy. With earlier recognition of the disease with proper appreciation of the complex problems encountered, and with better methods of treatment still further improvement in the results may be expected.

Tularemia Pneumonia. Report of a Fatal Case
Ross Pauli California & West Med 64 346-348, June 1946

Tularemia is an infectious disease caused by *Bacterium tularensis*. It is transmitted by infected animals, ticks, and flies. Whether the disease can be contracted by inhalation is an unsettled question. The pulmonary form has been considered rare, but an increasing number of cases is being reported.

The symptoms of tularemia pneumonia may be mild or the onset may be sudden and the course fulminating. Cough, fever (irregular and spiking), a relatively slow pulse, chill, diaphoresis, dyspnea and prostration are common. In severe cases cyanosis, delirium, stupor, and coma may occur. Roentgen findings vary with the type of the disease. Non typhoidal cases usually show early hilar adenopathy with subsequent retrograde extension of the involvement through lymphatic channels to the lung parenchyma or even the pleura. The typhoidal cases as a rule present primary parenchymal involvement. Lung abscess, pneumothorax, pleural effusion and residual fibrosis have been reported. Other aids to diagnosis are sputum studies which may reveal the organism, agglutination tests after the first week of the disease and animal inoculation.

The mortality rate has been reported as 40 per cent, bilateral cases having an especially poor prognosis. Therapy appears to be limited to symptomatic care, though some promising experimental results have been obtained with streptomycin (Helman Proc Staff Meet Mayo Clin 19 553 1944).

A case is recorded by the author which he believes may have been due to inhalation of the organism. It was diagnosed as atypical pneumonia, its true nature being discovered only postmortem.

MAURICE D. SACHS, M.D.

Primary Atypical Pneumonia A. B. Adams, G. L. Rolleston, J. M. Staveley, W. E. Henley and J. E. Caughey Brit M J 1 227-231 Feb 16 1946

The authors present a preliminary report dealing with the clinical laboratory and radiological data on 50

cases of primary atypical pneumonia occurring in the Naples area in 1945.

Fever, malaise, lassitude, and anorexia were present in all cases. Chills and sweating were present in over 50 per cent. Cough was present in 94 per cent. Headache was the most common neurological symptom. The sedimentation rate was moderately elevated. Eighteen cases (36 per cent) showed a positive heterophil antibody reaction. Increasingly positive cephalin-cholesterol flocculation reactions during the course of the disease were obtained in the majority of cases.

Positive radiological findings (parenchymal infiltration) appeared in the majority of cases from four to six days after onset of symptoms. Many infiltrations diagnosed as hilar in origin on the postero-anterior film were shown on lateral views to be in the apical segment of the lower lobe, and therefore to be peripheral rather than central lesions. No hilar adenopathy was noted. There were no instances of pleural effusion. Radiographic examination six weeks after onset showed complete resolution in the majority of cases.

[The positive cholesterol flocculation reactions and heterophil antibody reactions appear to be insignificant in such a small number of cases. Further data, as the writers suggest, would be needed to demonstrate the value of these tests in atypical pneumonia.]

ROBERT C. PENDERGRASS, M.D.

Bulla of the Lung E. Robert Wiese Dis of Chest 12 238-241 May June 1946

Bulla is a pathological entity caused by the confluence of two or more terminal elements of the bronchial tree; it is the result of an increased intra-alveolar pressure sufficiently great to stretch or destroy the inter-alveolar walls. It is usually associated with a vesicular emphysema.

Bullae occur following conditions which interfere with the normal respiratory mechanism, as tuberculosis, silicosis, tumors of the lung or mediastinum, localized scar tissue or edema of a bronchus, areas of atelectasis or consolidation and retention of heavy tenacious mucus within a bronchus. They are usually multiple, occupying those portions of the lungs which are most movable and least subject to continuous pressure from the chest wall, namely the upper anterior and mediastinal aspects. They vary in size from a small vesicle up to 9 or 10 cm. in diameter.

A bulla of appreciable size is demonstrable on the roentgenogram as a localized area of rarefaction surrounded by a thin sharply defined border which is in sharp contrast to the heavy outline seen as a rule in cavitation due to tuberculosis or lung abscess. Bullae may be mistaken for spontaneous pneumothorax. In the latter condition one can usually trace the line indicative of the lung surface to the mesial side of the air space. Not only is this line likely to be denser than the line seen in a bulla but in the majority of cases it courses toward the base of the lung while that in bulla curves upward to merge with the pleural shadow in the axillary line or to form an oval spheroid or even lobulated well illuminated space. Bronchiectasis and congenital and acquired cysts may also simulate bullae.

A bleb differs from a bulla in that it occurs with in interstitial emphysema, is formed by the rupture of an alveolar wall with subpleural escape of air, is movable under the pleura and has no direct communication with a bronchus.

HENRY K. TAYLOR, M.D.

by a roentgenogram of the sternum in the postero anterior oblique position. The embryology of the sternum is discussed.

THE DIGESTIVE SYSTEM

Congenital Stricture of the Oesophagus Richard Flynn M J Australia 1 702-703, May 18 1946

A case of congenital stricture of the esophagus is recorded. The patient was seen at the age of ten years with a history of dysphagia since birth. A roentgenogram showed almost complete stenosis at the level of the aorta with extreme dilatation above. Esophagoscopy revealed only a pin point orifice. Successive dilatations relieved the condition until a barium bolus of fair size could be swallowed. During the next three years dilatation was repeated at intervals and operation was then decided upon. This revealed aberrant veins crossing the esophagus which appeared to be responsible for at least a good part of the trouble. Division of these veins and further dilatations were followed by improvement and some months later the outlook was declared to be good.

The outstanding feature of this case is the obstruction due to aberrant veins, apparently springing from the azygos system. The report is a valuable contribution to our knowledge of esophageal stricture.

PERCY J DELANO, M D

Isolated Hodgkin's Disease of the Stomach. Donovan C Browne and Gordon McHardy Gastroenterology 6 596-601 June 1946

The authors add 2 cases of isolated Hodgkin's disease of the stomach to an estimated 20 previously reported. Roentgen examination of the stomach of their first patient showed indentations of the anterolateral aspect of the greater curvature, producing hemispherical filling defects in the cardiac region, with extensive mucosal irregularities. The proximal third of the stomach was fixed by adhesions. Peristalsis was sluggish. The patient died from massive gastric hemorrhage on the twenty eighth day following gastrostomy. Autopsy revealed Hodgkin's disease involving the upper two-thirds of the stomach and the perigastric nodes. No other sites of Hodgkin's disease were found. The roentgen findings in the second case were so similar to those in the first that a diagnosis of lymphogranulomatosis was suggested and this was confirmed at operation. The presence of sluggish peristalsis and the extensiveness of the roentgen defect, without a palpable abdominal mass, are notable features in these cases.

Megaduodenum Secondary to an Intrinsic Duodenal Diaphragm. Report of Case Victor Drucker and Emanuel S Cohen Am J Roentgenol 55 726-729, June 1946

Congenital duodenal obstruction is discussed with particular reference to an intrinsic duodenal diaphragm. When the embryo reaches the age of five weeks the lumen of the primitive gut is obliterated as a result of the proliferation of epithelial cells. Recanalization is soon effected however, by the formation and coalescence of vacuoles between the proliferated cells and the gastro-intestinal mucosa becomes histologically differentiated. The faulty recession of these cells is said to give rise to stenosis, atresia, and congenital diaphragm.

Duodenal diaphragmatic obstruction has been diagnosed at a wide variety of ages. Symptoms are present

during the first two weeks of life in 38 per cent of the cases, in 10 per cent symptoms appear between the third and eighth month, in 24 per cent between the ages of one and eight years, and in 29 per cent after twenty-four years. The diaphragm has been reported as proximal to the ampulla of Vater in 45 per cent of cases, opposite the ampulla in 20 per cent, distal to the ampulla in 25 per cent, and at the duodenojejunal junction in 10 per cent. Microscopically the diaphragm is usually composed of mucosa and submucosa. Roentgen examination, with or without contrast media, will often reveal the dilated duodenal loop above the point of obstruction.

The authors present a case of intrinsic duodenal diaphragm, the ninth of this nature in an adult to be reported in the literature. The patient, a woman aged 23, was admitted to the hospital complaining of fullness of the abdomen for two days, with slight nausea but no vomiting or abdominal pain. Her history showed that two days after birth repeated projectile vomiting of clear, watery material had occurred. The vomiting diminished in intensity and frequency until the age of six years, after which it ceased altogether. Roentgenograms of the stomach, taken at the age of five years were reported to show an abnormality of undetermined nature, for which surgery was recommended but refused. Physical examination on admission showed a soft, non-tender, tympanitic and distended upper abdomen. A gastro-intestinal series showed a somewhat enlarged stomach with tremendous dilatation of the first and second portions of the duodenum. In the region of the second portion the dilatation ended abruptly in a constriction, a few millimeters in diameter below which the duodenum assumed normal dimensions.

At operation a longitudinal incision was made through the constriction in the duodenum, revealing an intrinsic diaphragm with a central opening which barely admitted the tip of a Kelly clamp. The diaphragm was incised, and the longitudinal incision in the duodenum was closed transversely in order to widen the lumen at the site of obstruction. Two months after operation the patient was asymptomatic and stated that her upper abdomen had decreased in size. A gastro-intestinal series showed the duodenum to be of greater than average caliber, but considerably reduced as compared with the preoperative size.

H H WRIGHT, M D

Volvulus of the Sigmoid Colon. Discussion and Case Report. George C Burton J Arkansas M Soc 42 251-252, May 1946

The author believes that volvulus of the sigmoid colon accounts for 2 to 5 per cent of all hospital admissions for intestinal obstruction. It is the consensus of opinion that a redundant sigmoid with a long mesentery is a definite etiological factor. Constipation is said to be a contributing factor but, because of the prevalence of this condition such a statement is hard to prove.

In the acute type the onset may be sudden, with severe abdominal cramps, fever, and leukocytosis. In the subacute type, which is more common, constipation and gradual distention of the abdomen usually precede the onset of cramps. As the obstruction nears completion nausea and vomiting occur. Since the condition may be suddenly corrected by an enema, particularly if this is taken in the knee-chest position, it is always wise to question the patient on this point, as a history of repeated attacks may thus be obtained.

Roentgen therapy is futile in both benign and malignant neurogenic tumors

Ten *pericardial cysts* are included in the series. Discovery of the tumor in each instance was by routine roentgen examination. Except for their anterior position, there is nothing characteristic about the roentgenologic appearance of pericardial cysts to differentiate them from other mediastinal cysts. Since surgical extirpation is the only means of establishing the benignity of a mediastinal tumor, operation should be recommended.

Six *tumors of thymic origin* have been studied. In 4 instances the lesion appeared to be benign. One patient with advanced myasthenia gravis was operated upon, a malignant thymic tumor was found and could not be removed completely. There are no definite criteria for the positive roentgen diagnosis of thymic tumors. One author has observed that in many cases the tumor has a tendency to maintain the shape of the thymus, as seen in roentgenograms of children. Another suggestive finding is that often the tumor is easily seen in the frontal projection but is not so apparent in the lateral view. Treatment may be either surgical extirpation or radiation therapy depending upon the type of tumor.

Only 4 *mediastinal lipomas* have been removed. They have no distinctive roentgenographic features. Heuer and Andrus (Am J Surg 50: 146, 1940) predicted the true nature of a mediastinal lipoma in 2 cases because the shadow of the mass on the film became less opaque toward the periphery. This finding suggested to them that the tumor was composed of fat because it was more readily penetrable than the compact tissue of other tumors of the mediastinum.

The 14 *malignant tumors of the mediastinum* included 6 malignant teratomas, 2 thymomas, 1 neurosarcoma, 2 lymphoblastomas, and 4 cases of Hodgkin's disease. Except in 3 cases (all Hodgkin's granuloma) it was impossible to remove the tumor.

The role of radiation therapy in the treatment of mediastinal tumors is discussed. The author believes that the reluctance of physicians to recommend exploratory thoracotomy has probably resulted in the injudicious use of radiation therapy in many cases. Surgeons and radiologists experienced in thoracic disease should be able to predict in the majority of cases whether roentgen therapy will be successful. Even if errors in diagnosis occasionally result in thoracic exploration for tumors which will respond to radiation therapy, the danger to the patient from the operation is slight compared to the deleterious effects of prolonged and ineffectual irradiation. Most benign tumors of the mediastinum and some malignant neoplasms are amenable to surgical removal. Radiation therapy will fail to reduce the size or to halt malignant degeneration unless the tumor is of lymphatic origin. Moreover, after prolonged exposure to radiation, the removal of the lesion will be more difficult and hazardous.

Lymphomatous tumors of the mediastinum have a far greater tendency to produce clinical symptoms early and their roentgen appearance is fairly characteristic. If after a test dose of roentgen therapy the neoplasm decreases in size, it can be assumed that it is of the lymphoma group, and surgical intervention is not indicated. Properly employed radiation therapy is invaluable, both as a therapeutic and diagnostic measure. Friedman recommends an initial test dose of 750 r delivered to the center of the mass. It should

be emphasized, however, that about one third of malignant lymphomas will require as much as 1,500 r to affect the tumor. If, after a period of approximately one month there is no change in the size of the tumor, thoracic exploration should be performed to determine the exact nature of the lesion.

A Method for the Orthodiagraphic Measurement of the Transverse Diameter of the Heart by Means of the Simple Fluoroscope. Frederick H. Howard. Am Heart J 31: 724-727, June 1946.

The author describes a method for obtaining the true orthodiagraphic measurement of the transverse diameter of the heart with the use of the ordinary fluoroscope without any orthodiagraphic attachments. This method is applicable only when the screen and tube move as a single unit. As aids the author uses two triangular lead markers mounted on a tongue depressor (the apexes of the triangles are directed towards each other, and the bases are parallel and 10 cm apart) an ordinary wooden applicator, a grease pencil and a centimeter scale.

The tongue depressor with the lead markers is placed on the anterior chest wall, on a level with the second ribs and is held in place with adhesive. If the chest is irregular in conformation it may be necessary to bring forward one end of the tongue depressor by means of a wad of paper or cotton since the lead markers must be equidistant from the screen. The wooden applicator is attached vertically to the center of the screen with adhesive. The screen must be held in one plane during the procedure, close to but not in contact with the chest wall. Lateral mobility of the screen is necessary.

Under fluoroscopic observation the distance between the upper angles of the lead markers is indicated on the screen. This distance divided by 10 equals the magnification ratio, which is used as a correction factor for the subsequent measurements. The screen is moved so that the wooden applicator is tangential to the left border of the heart and the lower angle of the right lead marker (i.e., right relative to the observer) is indicated on the screen by a short vertical line. This same procedure is repeated on the right border of the heart and the lower angle of the left lead marker is indicated by a short vertical line. The interval between the two vertical lines is measured, divided by the magnification ratio and the result plus 10 equals the transverse diameter of the heart.

The logic for this procedure is discussed.

HENRY K. TAYLOR, M.D.

Congenital Anomaly of the Sternum—Vertical Non-Fusion. Report of Two Cases. Louis Gussow. Mil Surgeon 98: 420-424, May 1946.

Two cases of vertical non fusion of the sternum are presented. Clinically the presence of an otherwise unexplained round scar like depression in the upper midportion of the anterior chest accompanied by a skin fold suggests this anomaly. On forced inspiration with nose and mouth closed a long deep groove appears between the depression and the base of the neck, and on forced expiration a large round bulge at the base of the neck. Palpation strongly supports this impression. A standard postero-anterior roentgenogram of the chest is not of much help. In an over-exposed film however a large central area of diminished density will be observed in the widened upper mediastinum. The exact nature of the anomaly is shown

was placed first among preoperative possibilities. Of the three "pathognomonic" signs of choledochus cyst—pain, tumor, and jaundice—the first two were present. Jaundice was absent both clinically and on laboratory examination. Roentgen studies confirmed the presence of the mass, revealed its cystic character, and showed that it contained gas. The inability to demonstrate a normal gallbladder suggested involvement of the biliary tract. Taking films with the patient in various positions was helpful in outlining the walls of the mass and in showing something of their nature—the failure to collapse in various positions, for instance. Identification of the air within the cyst was significant, and the fluid level indicated the presence and amount of liquid.

Gas in the gallbladder was visible on the films and, as described by the roentgenologist, 'seemed to emerge from part of the tumor.' Its full significance was not appreciated before the abdomen was opened. It should be looked for in future cases and may be regarded as a finding of utmost importance. Being isolated so exactly in the different views, the gas obviously was not within loops of the bowel itself, its constancy of position precluded its being free air under the diaphragm. The logical inference is that the gas in the cyst and that trapped in the gallbladder came from the intestinal tract via the communication between the cyst and the duodenum. Fluoroscopy showing the duodenum crossing in front of the cyst, and roentgenograms showing the stomach from the side, containing barium which continued down in the duodenum in front of the cystic mass, were helpful. Of diagnostic value from the negative point of view was the fact that the gastro-intestinal and urinary tracts appeared roentgenologically normal.

The most plausible diagnostic possibilities other than choledochus cyst, were pancreatic cyst, solitary cyst of the kidney, hepatic cyst, and retroperitoneal cyst.

Operation consisted in removal of approximately nine tenths of the cyst and anastomosis of the remaining portion of the dome (that part into which the cystic and common hepatic ducts entered) to the duodenum. The postoperative course was uncomplicated.

Celiac Disease. Survey from the Children's Hospital, Melbourne. G E M Scott. M J Australia 1 659-665 May 11, 1946.

Celiac disease is a chronic disorder of early childhood characterized by the passage of large pale fatty and offensive stools accompanied by severe wasting and interference with bodily growth. It is not common in seen among rich and poor alike and is usually said to affect girls a little more frequently than boys. The author traces the history of the study of the disease from the original description by Gee in 1888 to the present. These patients are usually under five years of age, show great muscular weakness and tenderness with a soft flabby feel to the flesh, have abdominal distention, are often anemic and may show tetany and achlorhydria. There is usually no mental retardation but epiphyseal development and growth are often deficient.

Pancreatic fibrosis and associated respiratory infection have been shown to be the etiological factor in some cases. In others a similar clinical picture was evidenced with tuberculous involvement of the abdominal nodes. Still others show neither of these changes but may be attributable to a vitamin deficiency. In all there is apparent a definite disturbance in carbohydrate and fat metabolism associated in many with disturbance in the calcium balance.

Radiological studies of the small bowel were reported by May and McCreary (J Pediat 18 200, 1941) as showing tendencies toward "clumping" of the barium bolus in conjunction with low blood-sugar curves, but these findings were not considered diagnostic, being present also in disease of the pancreas, sprue, cretinism, infections, and occasionally in normal subjects. The disordered calcium metabolism frequently accompanying the disease may produce x-ray changes in the bones, such as delay in ossification and bony growth, transverse lines in the metaphyses, osteoporosis, osteomalacic deformities, celiac rickets and dwarfism.

The author reviews 35 cases studied over a period of ten years. Twenty three of his patients were males and 12 females. The average age of onset was two years and eight months. Six of the patients died, the average age being four years and eight months. Causes of death included toxic hepatitis, bronchopneumonia, thrombocytic purpura, acute gastro-enteritis with hemorrhage, pyelonephritis, and urethral calculus. Only one case is mentioned in which fibrocystic disease of the pancreas was found. Many of those who survived had moderate elevation of temperature over prolonged periods. No radiological evidence of rickets was found but osteoporosis was observed. Many of the patients were below the average height and weight for their age.

BERNARD S KALAYJIAN M D

THE DIAPHRAGM

Congenital Hernia of the Diaphragm. Robert E Gross. Am J Dis Child 71 579-592, June 1946.

Most congenital defects of the diaphragm can be repaired by surgical means. The present report concerns 7 cases all successfully treated.

Most commonly diaphragmatic hernias appear in the posterior or posterolateral portion of the left leaf. About 10 per cent of them have a true hernial sac which limits to some degree the extrusion of abdominal viscera into the chest.

Symptomatology depends on the extent to which the viscera are drawn into the chest and on the degree of lung compression. In the esophageal hiatus type there is seldom much difficulty in infancy. Later, mucosal erosion may cause melena and anemia. Emesis, pain or the signs of high obstruction may also occur. In one of the present series there was herniation of an anomalous lobe of the liver into the pericardium.

The majority of cases of congenital diaphragmatic defects give severe symptoms shortly after birth. Cyanosis, vomiting, and physical signs dependent on the type and contents of the herniated structure are usually found. From a surgical point of view, the author believes that in most such cases the roentgenologist can supply all the necessary information from frontal and lateral views made with the patient upright. He considers fluoroscopic study after administration of a barium meal or enema superfluous as information gained from such procedures does not alter the operative procedure and adds to the surgeon's difficulties. The size of the hernial mass, the state of lung compression and the position of the heart are the main data desired by him.

Ingestion of a barium meal is advantageous however in cases of esophageal hiatal hernia. The length

Examination will usually show pronounced abdominal distention usually some diffuse tenderness and absence of audible or visible peristalsis due to the fact that the huge gas filled loop of the sigmoid colon rises high in the abdomen, overlying the active intestine beneath. Often the diagnosis can be made from a single flat film. Usually this will show an enormous dilated loop of what is obviously colon and some dilatation of the rest of the large bowel with gas. If a barium enema is given there is likely to be complete obstruction in or near the rectosigmoid, while the termination of the barium column in the rectum is smooth in contradistinction to the irregular obstruction seen with carcinoma which is the most important condition requiring differentiation. There is usually absence of gas in the small intestine.

The author describes the case of a 68-year-old woman with volvulus of the sigmoid of the subacute type with symptoms present for several days before complete obstruction ensued. At operation a large segment of the sigmoid was found to be enormously dilated. A temporary colostomy as well as a sigmoidopexy was done. The colostomy was later closed and the patient was discharged in good condition. While treatment varies with different surgeons there is general agreement that anything less than resection is inadequate.

BERNARD S. KALAVJIAN, M.D.

Action of Appendicular Extracts on the Motility of the Large Intestine. Radiologic Observations. Pietro Perona and Mario Rigon. *Arch. di radiol. (Naples)* 18: 188-196, July-October 1942.

The study recorded in this paper was made with the view of obtaining information about the function of the appendix. After injection of 1 cc or of 2 cc of extract of bovine appendix (equivalent to 5-10 grams of fresh organ) the authors found in eight patients a more or less definite tonic effect on all the segments of the colon. This was rarely limited to the proximal colon. After a double dose (4 cc) the effect was more constant and more pronounced and of longer duration in twelve cases. The authors reproduce some roentgenograms in fifteen figures. Whether this study will have a practical clinical application remains to be seen.

E. T. LEDDY, M.D.

Proctoscopy and Barium Colon Study in the Diagnosis of Rectal Conditions. Isaac Skir. *New York State J. Med.* 46: 1017-1018, May 1, 1946.

The author gives several case reports illustrating the fact that lesions in the rectosigmoid may be missed on barium enema examinations. He makes a plea that barium studies of the colon be preceded by digital and proctoscopic examination of the rectum. Use of the barium enema examination first may interfere seriously with visual examination and may engender a false sense of security in patient and physician.

ROBERT C. PFENDERGRASS, M.D.

Spontaneous Gastro-Intestinal Biliary Fistulas. N. Frederick Hicken and Q. B. Coray. *Surg. Gynec. & Obst.* 82: 723-730, June 1946.

The authors review 272 reported cases of spontaneous gastro-intestinal biliary fistulas and report 15 of their own operated cases. They state that these fistulas are not medical curiosities but occur in approximately 4 per cent of all patients requiring surgical therapy for disorders of the biliary tract. In 90 per cent of the reported cases gallstones were the etiologic factor.

Perforating peptic ulcers were the responsible agent in 6 per cent. Ulcers on the posterior surface of the duodenum usually perforate into the choledochus while those on the lateral duodenal wall ulcerate through into the gallbladder. Gastric ulcers invariably involve the gallbladder. Cancer of the stomach, pancreas, gall bladder and common bile duct produce a degenerative necrosis of contiguous viscera so that a variety of internal biliary fistulas result.

An analysis of 272 case reports shows that the gall bladder was involved in 88 per cent and the common bile duct in 11 per cent. The gastro-intestinal component consisted of the duodenum in 69 per cent, colon in 26 per cent and stomach in 4 1/4 per cent.

When a fistula occurs it either causes serious disturbances of the hepatobiliary system or it closes spontaneously. Generally a suppurative cholangitis, hepatitis, and obstructive jaundice result. The occurrence of a suppurative cholangitis which is seldom observed in surgically produced fistulas, is explained by the presence of a concomitant choledochal obstruction with resulting stasis of bile. Cholangiographic studies performed on the operating table confirm the presence of such obstruction and are of primary importance in surgical treatment.

Gastro-intestinal biliary fistulas produce no identifying signs or symptoms but mimic the syndrome of the underlying condition. Symptoms are intensified with onset of the fistula.

Preoperative diagnosis depends entirely on the radiologist but Borman and Rigler (*Surgery* 1: 349, 1937) were able to make a correct radiologic diagnosis in only 37 per cent of 24 cases. Their review of the literature showed a preoperative diagnosis (in each instance by the radiologist) in 30 per cent of 267 cases. The demonstration of ingested barium, gas, or both, in any segment of the biliary tree is presumptive evidence of a fistulous communication. Most important is the finding of barium in the biliary radicles. The biliary and gastro-intestinal components can generally be recognized fluoroscopically. A relaxed sphincter of Oddi may occasionally allow biliary reflux but here there is rapid elimination of the barium while in the presence of a fistula the barium remains in the biliary system for six to twelve hours. Emphysematous cholecystitis may be differentiated by absence of reflux in barium meal studies. Acute intestinal obstruction due to migrating gallstones may occur and may be demonstrable on scout films or following the ingestion of a thin barium mixture. Cholecystocolic fistulas can usually be identified with the aid of a barium enema. If not a double contrast enema may be necessary.

The authors emphasize the importance of adequate preoperative preparation and individualization in treatment. Cholangiographic studies made on the operating table are most useful providing the surgeon with an accurate blue print of the problems confronting him. The primary surgical procedure is generally to effect free biliary drainage by choledochostomy before any major corrective procedure is attempted. The surgical procedures for the various fistulas are discussed. Prognosis is fairly good except in cases due to neoplasia.

JOHN A. COCKE, M.D.

Choledochus Cyst. Edward F. McLaughlin. *Ann. Surg.* 123: 1047-1062, June 1946.

A case of choledochus cyst is presented. It is unique in that the patient was a Negro and that the diagnosis

The usual lesion in early syphilis is a periostitis. Osteitis is more frequent in early than in late syphilis. Pathological fractures are more commonly the result of neurosyphilis. The response to treatment is usually good in early syphilis of bone but not so in late syphilis.

Radiographically the improvement depends upon the type of bone involvement. Proliferative change seldom shows improvement, while destructive lesions usually show bone regeneration. JOHN B McANENY M D

Pulsating Benign Giant Cell Tumors of Bone Report of a Case and Review of the Literature Thomas A. Shallow and Frederick B. Wagner, Jr Arch Surg 52 861-876, June 1946

'Pulsating benign giant-cell tumor of the bone' is a benign type of tumor which apparently as the result of free communication with large blood vessels, grows to a large size, pulsates, and occasionally yields a bruit. Because the physical signs simulate those of true arterial aneurysm, the lesion has been regarded as a form of so-called bone aneurysm. Although the comparatively rapid growth rate and large size of the tumor create a suspicion of malignancy, its benign character is demonstrated by the long survival and histologically by the absence of findings of hyperchromatism, mitosis, and other features of osteogenic sarcoma. There is nothing in the histologic findings however which differentiates pulsating and non-pulsating types of benign giant-cell tumor.

The differential diagnosis of the pulsating tumor is often exceedingly difficult. Telangiectatic osteogenic sarcoma, angioendothelioma metastatic carcinoma, and hemangioma are other types of tumor which may show pulsation. Telangiectatic sarcoma usually occurs in young persons, grows rapidly with destruction of the shaft of the bone leading to pathological fracture, and as a rule terminates in death from metastasis within a few months. Pulsating metastatic carcinoma usually results from a primary tumor in the kidney or thyroid, follows a slow course and is generally found in middle-aged and elderly persons. Hemangioma and angioendothelioma are usually found in adult and middle-aged persons; the former in almost any bone and the latter usually in the long bones. The radiological picture of hemangioma is often typical, showing the peculiar striations, which are vertical in the vertebrae. In all of these tumors the histologic picture is the best source of distinction.

The treatment for pulsating benign giant-cell tumors should be wide surgical resection. Radiation is usually only moderately effective. In the extremities the end-result is often an amputation. The prognosis for life is excellent.

To the six previously reported cases the authors add a seventh in which curettage followed by roentgen therapy to a lesion in the upper end of the tibia was unsuccessful and amputation was eventually required. LEWIS G JACOBS M D

Case of Raynaud's Disease with Osteopathy Late Effect of Treatment with Marcom-Therapy G. Frada. Arch di radiol (Naples) 18 151-156 July October 1942

The author reports a case of Raynaud's disease of the hands with gangrenous ulceration, which did not respond favorably to ordinary treatment nor to periarthral sympathectomy. Roentgenograms of the hands are reproduced showing the bony changes. A

satisfactory result was obtained by the use of short-wave therapy applied to the cervicodorsal spine. E T LBDY, M D

Ruptured Intervertebral Disk Simulating Angina Pectoris Allen Izard Josey and Francis Murphey J A M A 131 581-587, June 15, 1946

A ruptured lower cervical intervertebral disk frequently is associated with the anginal syndrome, the precordial pain simulating that of coronary artery disease. The nerve pathway for the production of this pain is unknown.

Seven cases of ruptured cervical disks are discussed. Operation had been done in three, with subsequent complete relief of precordial pain. The other patients were reassured concerning their cardiac status.

The authors conclude that all patients suspected of angina pectoris or coronary disease in whom symptoms, signs, and laboratory studies are inconclusive should be investigated for possible herniation of cervical nucleus pulposus. Differential diagnosis can be made on the basis of history, physical examination, electrocardiographic studies, and cervical spine roentgenography.

Lateral views of the cervical spine show straightening or a slight kyphosis curvature replacing the usual lordotic curve, with acute forward angulation at the level of the ruptured disk in many cases. Narrowing of the intervertebral disk space may also be seen in the lateral projection. A reduction in size and alteration in shape of the intervertebral foramen may be noted in the oblique view. Localized arthritic changes may be present. An osteophyte may be seen projecting within the intervertebral foramen representing calcification in the annulus fibrosus and the posterior longitudinal ligament over a previously herniated nucleus pulposus.

H D WELSH, M D
(University of Michigan)

Spontaneous Dislocation of the Hip Joint. K. Lenggenhager Schweiz med Wchnschr 76 381-384, May 4, 1946

It is well known that the hip may be dislocated after a purulent infection but not so well known that similar dislocation may follow a sterile effusion, either primary or secondary to nearby inflammatory disease. The mechanism depends on the lessened effectiveness of the external atmospheric pressure and the muscular atrophy which permit the femoral head to come out of the socket from behind forward, especially if the joint is held in semiflexion. The head is then able to move upward in response to normal muscle pull. Early diagnosis permits reduction with full recovery. The best prophylaxis is axial traction in abduction without flexion. Four illustrative cases are reported.

LEWIS G JACOBS, M D

"March Fracture" of the Fibula in Athletes Harry R. McPhee and C. Montanye Franklin J A M A 131 574-576 June 15, 1946

Six cases of so-called 'march fracture' of the fibula and one of the foot occurring in athletes, have been encountered by the authors. Early x rays showed nothing or at most a suggestive haziness of the periosteum. Later definite fuzziness similar to that seen in periostitis developed at a point along the bone and more frequently than not was accompanied by a doughy infiltration and swelling in the overlying soft tissues. A

of the esophagus amount of stomach above the diaphragm, and presence of gastric of duodenal obstruction may be determined by this method

In the rare case of herniation into the pericardial sac, angiocardigrams were employed to prove that the abnormal bulge of the cardiac shadow did not represent a dilated chamber

M WENDELL DIETZ, M D

Para-Esophageal Hiatal Hernia. A Case Manifesting Gastrointestinal and Cardiac Symptoms and Presenting Itself on X-ray as a Mediastinal Tumor Myron Herman and Emanuel Singer New York State J Med 46 1020-1023 May 1, 1946

The authors call attention to the fact that diaphragmatic hernia may produce pain similar to that of coronary disease Their patient was a 53 year-old white man admitted for treatment of a minimal pulmonary tuberculous lesion and observation because of a recent coronary occlusion There were few symptoms until the age of fifty when attacks of substernal pain together with an inverted T wave in the electrocardiogram, led to a diagnosis of coronary disease Unexpected improvement in the electrocardiogram with return of the T wave to normal caused the cardiologist to suspect extracardiac factors A rounded shadow in the lower mediastinum was found on barium examination to be due to herniation of a portion of the stomach

ROBERT C PENDERGRASS M D

Primary Cystic Tumor of the Diaphragm Orland B Scott and Douglas R Morton Arch Path 41 645-650, June 1946

To the 14 cancerous and 18 benign primary tumors of the diaphragm previously reported the author adds a primary diaphragmatic cyst of undetermined origin Neoplasms of the diaphragm do not always produce symptoms and, when present, these follow no specific pattern Roentgenography is of the greatest value in establishing a diagnosis and in differentiating between abdominal and intrathoracic masses Intrathoracic tumors touching the diaphragm show motion synchronous with the normal respiratory excursion of the diaphragm If the tumor lies underneath the diaphragm and protrudes through it into the thoracic cavity a paradoxical movement of the tumor shadow is observed similar to that characteristic of diaphragmatic hernia The paradoxical movement of a diaphragmatic hernia may not be demonstrable however in the presence of adhesions within the hernial contents Diagnostic pneumothorax is useful in differentiating lesions in the base of the lung Pneumoperitoneum may aid in outlining the position of the tumor Roentgen examination of the gastro-intestinal tract will rule out lesions involving the stomach or the bowel When cystic tumors with calcified walls are encountered in tridermal or complement fixation tests are indicated to exclude echinococcus cysts

Details of the 32 previously recorded diaphragmatic tumors are tabulated

THE MUSCULOSKELETAL SYSTEM

Juvenile Rheumatoid Arthritis (Still's Disease) James A. Coss, Jr M Clin North America 30 563-575 May 1946

The apparent differences in rheumatoid arthritis occurring in young persons (Still's disease) and in adults

are due to the varying effect of disease processes in youth and maturity As in adults the disease in the young occurs more commonly in females. The highest incidence in children is between the second and third years of life The pathologic findings are similar to those of adult arthritis Muscle atrophy however, is more marked and bony lipping or spurring is rarely seen lymph node hyperplasia, splenomegaly, and hepatomegaly are more common Myocardial endocardial, and pericardial lesions similar to those of rheumatic fever are occasionally seen in juvenile arthritis Adhesive pleurisy is a frequent finding in cases coming to autopsy

Three types of localized skeletal change resulting from Still's disease, one or more of which are present in nearly 40 per cent of these cases have been observed by the author 25 per cent of the patients have an under developed mandible (brachygnathia), 13 per cent have luxation or fusion of two or more cervical vertebrae, and about 10 per cent have abnormal shortening of one or more fingers or toes These changes were observed in normal subjects with no growth disturbances prior to the onset of arthritis The etiology of Still's disease, as of adult rheumatoid arthritis, has not been determined, certain predisposing factors are common to both groups

Bone changes do not take place early and definite arthritis may be present without any significant roentgen manifestations Regardless of the patient's age at the onset of rheumatoid arthritis the earliest and most common finding is soft tissue atrophy swelling, or effusion Next in frequency is decalcification a decrease in bone density without loss of form Joint space narrowing or obliteration is seen only when the articular surfaces are damaged Bone destruction also appears late and consists of localized loss of calcium, demonstrable roentgenologically as punched-out areas near epiphyseal lines Some other features peculiar to Still's disease are (1) the previously mentioned growth changes (brachygnathia brachydactylia, and cervical fusion or luxation), (2) thickening of the periosteum on the shaft of metacarpals or metatarsals and phalanges, often giving a heavy appearance to these bones, (3) thinning of the shafts of phalanges etc occasionally giving a delicate appearance quite opposite to the above (4) accelerated growth of epiphyses, resulting in a disparity in the length of the long bones Symptomatology laboratory findings, and treatment are discussed

Osteous Syphilis Report of a Case. Mark Exley and A W Newton New England J Med 234 661-664 May 16 1946

This is a report of a patient who complained of pain in his right arm and both thighs thirteen months after a rash Kahn and Eagle tests were positive X ray examination showed destruction of the humerus between the mid and distal thirds with periosteal reaction In the lower left tibia there was a severe osteitis with bone erosion and periosteal elevation The femurs showed proliferation with erosion Six months later the right humerus was fractured by bumping it against a chair Areas of decalcification were now demonstrable in the parietal and frontal bones The lesions previously observed had progressed Treatment was now accepted for the first time In four months there was marked improvement in the bones with healing of the fracture but unfortunately the patient failed to return after this

ing typical instances of destruction (beyond the "fringing" stage) in the upper poles, filling defects, dilatation of an infundibulum, contraction or stricture of a calyx, dilatation of a calyx (*dilatation en petale*), pyonephrosis, calcification, an abscess cavity communicating with a calyx, stricture at the ureteropelvic junction, also one case in which the filling defect simulated the appearance of a cystic kidney. Just to look at the illustrations is worth while as a review of the cardinal radiographic signs of renal tuberculosis.

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The orifices of bilateral ectopic ureters are most frequently situated in the urethra or vestibule of the vagina. The condition is much more frequent in the female in whom the outstanding symptom is urinary incontinence both diurnal and nocturnal. In the male, incontinence is usually absent and the condition is discovered following investigation to determine the source of a urinary tract infection.

If bilateral ectopic ureters are suspected, careful examination must be made of the urethra, vestibule and vagina for the escape of urine from an ectopic orifice. It may be possible to catheterize the ectopic ureters and to secure pyelograms as in one of the cases reported by the authors.

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This article consists of 11 brief case reports which illustrate the increasing importance of cerebral angiography in the diagnosis of intracranial lesions of vascular origin. Emphasizing the fact that the usefulness of the technic depends largely upon proper selection of patients and careful correlation of clinical and roentgenographic findings, the authors describe the neurologic and angiographic features of intracranial aneurysm, angiomatous malformations, occlusion of the internal carotid artery and traumatic arteriovenous aneurysm.

Intracranial aneurysms usually are congenital in origin and the majority occur in the anterior portion of the circle of Willis. In the arteriogram the aneurysm appears as a saccular pouch adjacent to the artery from which it arises. The size of these lesions shows great variation.

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Occlusion of the internal carotid artery may be due to arteriosclerosis, thrombosis, embolism, obliterating syphilitic arteritis, and non-syphilitic arteritis. Whereas clinical findings, plain roentgenograms of the skull, and encephalograms are seldom conclusively diagnostic, angiographic findings are characteristic. The internal carotid artery can be traced to the point of obstruction, and its cerebral branches are not visualized. If the patent vessel on the opposite side is injected, the vessels supplying both cerebral hemispheres can be seen.

Traumatic arteriovenous aneurysm implies the formation of a fistula between the carotid artery and the cavernous sinus or some other venous channel. Such lesions can be diagnosed in most instances by a bruit which may be audible to both patient and physician. Direct visualization of the lesion is readily obtained through angiographic examination.

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Thromboangitis of Pulmonary Vessels Associated with Aneurysm of Pulmonary Artery. Report of a Case. L. E. Thompson and B. Gerstl. *Arch. Int. Med.* 77: 614-622, June 1946.

An aneurysm of the right pulmonary artery, more than 10 cm. in diameter which developed within a period of three months and was associated with thromboangitis of both pulmonary arteries and veins is reported. Several features of this case are of particular

definite fracture line with lateral radiations appeared in about four weeks. The process became sharply defined and subsided to a spindle-shaped swelling along the bone. The complete cycle of disability took ten to fourteen weeks, and attempts to modify the course by early immobilization were unsuccessful. The authors question the existence of a hidden 'fracture-from-the-beginning' theory in view of the clinical picture in cases of known fracture, and believe that some other factor besides simple fracture is involved in these conditions.

Osteochondrolysis Circumscripta of the Astragalus (Osteochondritis Dissecans of König) Dino Agati Arch di radiol (Naples) 18 143-150, July-October 1942

Agati reports and illustrates two cases of osteochondritis dissecans involving the astragalus and discusses some points of clinical and roentgenologic differential diagnosis
E T LEDDY M D

Significance of Minor Bone Injuries. H W Gilles Brit J Radiol 19 173-177, May 1946

In fractures injury to the ligaments and other soft tissues is often of more importance in producing disability and delaying healing than the bony injury. The radiologist should always attempt to determine the extent of the ligamentous injury. Small flakes of detached cortex and chip fractures are indications of avulsion of the ligaments. The more usual sites for these injuries are the carpal bones, phalanges tarsal bones, the elbow, shoulder and ankle.

SYDNEY J HAWLEY M D

GYNECOLOGY AND OBSTETRICS

Evaluation of a New Contrast Medium for Hysterosalpingography John B Montgomery and Warren Lang Am J Obst & Gynec 51 702-705, May 1946

The authors have found visco-rayopaque, which was introduced by Rubin in 1941, to be highly satisfactory for x ray study of the uterine tubes. The outstanding advantage of this substance is due to the fact that it is well tolerated by the tissues and is rapidly absorbed from the peritoneal cavity. It was used to study the patency of the uterine tubes in 79 patients. The tubes were closed in 54 of this number; in the remaining 25 the medium flowed freely into the peritoneal cavity where it was absorbed within thirty minutes.

Now that such a medium is available gynecologists and radiologists need have no hesitancy in carrying out hysterosalpingography in all patients in whom uterine tubal insufflation indicates obstruction.

F B MARKUNAS M D

Roentgen Pelvimetry J N Ané New Orleans M & S J 98 497-501 May 1946

The Johnson method of stereoroentgenometry was used by the author for determining the pelvic diameters because of its accuracy and adaptability to available equipment and because it permits stereoscopic study of the pelvis. The Ball technic is recommended for cephalometry. These two procedures with sacral measurements complete the study of the individual case.

In a series of 1,767 cases the pelvises were classified under three headings: normal, with normal or greater than normal diameters 55.9 per cent; borderline, with contraction of 5 to 10 mm in one or more diameters

27.7 per cent, contracted with 10 mm or more contraction in one or more diameters, 16.1 per cent. The average normal pelvic diameters as determined by this study compare closely with those given by Williams. A valuable table shows the average diameters in the various types of pelvis according to the Caldwell-Moley classification.

The author measures the posterior sagittal diameter of the inlet and midpelvis as well as of the outlet. He finds that this measurement at the inlet aids in the classification of the pelvis and at the midpelvis helps to determine the amount of room present for turning of the fetal head. If the sum of the bischial and posterior sagittal diameters at the midplane is less than 13.5 cm, difficult delivery may be expected. The minimal figure at the outlet is given as 17 cm, the sum of the intertuberous and posterior sagittal diameters.

Considerable attention is paid to the study of the sacrum. A line drawn from the promontory to the tip of the sacrum subtends the sacral curve and has been called the "chord." In this series, the chord varied from 7.8 cm to 17.2 cm with a mean of 11.5 cm. A perpendicular from the chord to the deepest portion of the sacral curve has been called the "sacral index." The average of this measurement has been found to be 2.2 cm with variations from 0 to 5.9 cm. The sacral angle is measured at the intersection of the chord and the plane of the inlet; the average measurement is 72 degrees, with a variation from 51 to 98 degrees. The long straight sacrum set at a small angle to the pelvis has long been recognized as an obstetrical hazard. The well curved short sacrum in which the radius of the arc is too small to accommodate the fetal skull is another source of difficulty. The relationship of the chord index and angle of the sacrum should be considered in borderline cases especially where an adequate posterior pelvis is essential for safe delivery.

The size and shape of the sacrospinous notch determine the space available in the posterior segment of the inlet. In the android pelvis the notch is relatively narrow and angular at its apex. In the anthropoid pelvis the notch is relatively long and more curved. The platypelloid pelvis presents a notch similar in form but shorter than the gynecoid type.

The subpubic arch varies from the narrow angular form of the android to the wider curved arch type of the gynecoid pelvis. Its size and shape are closely related to the shape of the forepelvis and to the inclination of the sidewalls of the pelvis which may be divergent, straight, or convergent. It is difficult to express the form of the arch in strictly mathematical terms. The inclination of the sidewalls should be considered with measurement of the bischial diameter to determine whether contraction is due to large ischial spines or a narrow converging pelvic cavity.

The question of whether or not the baby can be born normally cannot be settled by x ray studies alone, but only in combination with clinical examination and obstetrical judgment.

BERNARD S KALAYJIAN M D

THE GENITO-URINARY SYSTEM

An Estimate of the Value of Radiologic Examination of the Tuberculous Kidney R Hickel J de radiol et d'electrol 27 187-195 1946

This article on the radiologic study of the tuberculous kidney is well illustrated with informative views showing

ing typical instances of destruction (beyond the "fringing" stage) in the upper poles, filling defects, dilatation of an infundibulum, contraction or stricture of a calyx, dilatation of a calyx (*dilatation en petale*), pyonephrosis, calcification, an abscess cavity communicating with a calyx, stricture at the ureteropelvic junction, also one case in which the filling defect simulated the appearance of a cystic kidney. Just to look at the illustrations is worth while as a review of the cardinal radiographic signs of renal tuberculosis.

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interest The development of a large aneurysm in three months, without murmurs or palpitation, may be explained by assuming that the force of the flow of blood while sufficient to expand the damaged arterial wall, engendered such velocity that the physical signs usually associated with saccular aneurysm were not produced Various causes for the changes in the pulmonary vessels are considered It is suggested that the condition described may represent a variety of periarteritis nodosa If so the unusual involvement of the larger pulmonary vessels would add a new feature to the already complex syndrome of periarteritis

Translumbar Aortography Its Diagnostic Value in Urology A Keller Doss J Urol 55 594-606, June 1946

Translumbar aortography, though introduced by dos Santos more than fifteen years ago has advanced little beyond the field of medical curiosity The author has used the technic almost routinely in the study of renal disease during the past five years and believes that with the development of a suitable non-toxic medium, it will become a standard procedure

Since the foundation of an organ is dependent to a large extent on its blood supply, renal arteriography not only aids in the early diagnosis of pathological processes in the kidney but also offers a visual means of estimating its function This knowledge is of great value especially from the surgical point of view, for often a large hydronephrotic kidney or the kidney filled with a staghorn calculus, considered fit only to be removed, may be found to be well worth saving Congenital or acquired ectopia can be more intelligently and scientifically handled by means of aortography, since attenuation of the renal pedicle associated with pain and relative delay in emptying of the pelvis makes possible a correct decision with respect to nephropexy This surgical procedure will therefore be employed less often and with a much higher percentage of satisfying results

The author has found the study useful as an aid in the diagnosis of simple solitary cysts hypernephroma renal duplication and in obstructions at the ureteropelvic junction due to aberrant vessels In the presence of a retroperitoneal tumor, it is possible to exclude or convict the kidney in nearly every instance The rare case of Goldblatt hypertension can be definitely established if obstruction or occlusion of one of the renal arteries can be demonstrated Sixteen illustrations are included showing how the renogram has been of aid to the author in the diagnosis and management of renal disease

JOHN H FREED, M D

Abdominal Aortic Aneurysm Simulating Perinephritic Abscess Dorsolumbar Scoliosis A Roentgen Sign of Aneurysm Frederick B Mandeville Urol & Cutan Rev 50 261-264 May 1946

Demonstration of erosion of the vertebral bodies with preservation of the intervertebral disks on a lateral roentgenogram in association with a pulsating abdominal mass, is generally accepted as practically the only evidence of aneurysm of the abdominal aorta The author reports 3 cases showing the classical findings on the lateral film and in addition, a dorsolumbar scoliosis in the anteroposterior view, a finding which is usually considered highly suggestive of a perinephritic abscess A number of cases of aneurysm simulating perinephritic abscess are cited from the literature.

MAURICE D SACHS M D

THE SPINAL CORD

Opaque Myelography in Penetrating Wounds of the Spinal Canal C L Hinkel and R L Nichols Am J Roentgenol 55 689-709, June 1946

World War II afforded the first opportunity for myelographic examination of considerable numbers of patients with penetrating wounds of the spinal cord and cauda equina The authors employed this procedure in a large number of cases and found it useful in localizing and analyzing lesions and as a guide to surgical treatment Patients with paralysis thought to be due to transection of the spinal cord or cauda equina were in many instances found to have surgically remediable lesions, and in some, operation several months after injury effected relief of the neurological symptoms Thirteen of the patients in whom myelographic examination was done were operated upon, and correlation of the findings permitted evaluation of the significance of abnormalities seen in the myelographic picture The major myelographic abnormalities encountered fitted into the following categories

1 *Sharply localized, clearly margined indentation* This defect indicates localized external pressure on an intact dura It was always found associated with fractures of and loose bone chips from the laminae or pedicles With surgical removal of the bone fragments the prognosis is good The defect may be missed unless oblique or supine projections are used

2 *Angulation* is the result of scarring and contraction of the dural and epidural soft tissues or of traumatic unilateral severance of the nerve roots and the dentate ligament which normally stabilize the dural tube.

3 *Extra-arachnoid oil (near lesion)* Except when it is due to faulty technic the presence of oil outside the subarachnoid space indicates a tear in the arachnoid

4 *Displacement of the column of oil* Dorsal or ventral displacement of the arachnoid contents may occur from anything which fills the subdural or epidural spaces Lateral displacement has not been noted The defect was found only in the presence of blood or blood clot between the dura and the bony neural canal

5 *Feathery irregular filling defects* (localized partial obliteration of the subarachnoid space) are due to pia arachnoiditis

6 *Altered physical characteristics of the oil* When pantopaque is used its dispersion into fine droplets has been found to be associated with alterations in the cerebral spinal fluid Nearly all of these cases show high cerebral spinal fluid protein Two cases showed xanthochromia.

7 *Complete subarachnoid block* may occur as the result of extrinsic pressure intrinsic pressure active inflammatory disease or scarring as the result of very extensive destruction of nerve tissue.

The technical considerations are discussed in detail, and condensed reports of the thirteen cases are presented in table form

H H WRIGHT M D

TECHNIC

Two Mechanical Devices for Reducing the Risk of Radiation Exposure During Certain Types of Roentgen Examinations B J Markman Acta radiol 27 388-391, May 6 1946 (In English)

The author describes new apparatus for distant manipulation of the contrast medium syringe in urethro-

raphy and for the administration of the enema in examinations of the colon which reduce the radiation risk for examiner and assistants

Girdle for Compression of the Ureter Erik Lundström *Acta radiol* 27 385-387, May 6, 1946 (In German)

The author describes a girdle-shaped contrivance for compression of the ureters during intravenous and retrograde pyelography. A gentle compression is obtained, without fixation of the patient on the examination table.

Radiologic "Chronocinography" Value of the Demonstration of Motion in Relation to Time José

Moretzsohn de Castro *Radiologia* (Buenos Aires) 8 23-28, January-April 1945

Brazilian Method of Clinical Cineradiography José Jany *Ibid* pp 29-43

Contribution to the Cineradiographic Study of Gastroduodenal Motility José Moretzsohn de Castro and Joao Ferreira *Ibid*, pp 44-49

Contribution to the Study of the Physioradiology of the Small Intestine José Moretzsohn de Castro and José Fernandes Pontes *Ibid*, pp 50-59

These four papers are devoted to the cineradiographic technic devised by Jany and Moretzsohn de Castro of Brazil, called by them *cronocinegrafia radiologica*, and to its application to the study of gastroduodenal and small intestinal physiology.

RADIOTHERAPY

NEOPLASMS

Possible Progress in the Radiotherapy of Cancer (Neutron Therapy, Joliot Therapy, Alpha Therapy, Beta Therapy, Gamma Therapy, and Ultra-Gamma Therapy) Robert Coliez *J de radiol et d'électrol* 27 177-186, 1946

This is an excellent article on nuclear physics and will be of special interest to anyone whose work leads him into this field, though the amount of higher mathematics which goes with a doctor's degree in physics is really a prerequisite to a complete comprehension of all the author sets forth. Nevertheless, those with the average physician's background in physics can get a great deal of substantial information from the paper. It contains a very clear exposition of the principles of Lawrence's cyclotron, and the diagrams in which the production of neutrons by the bombardment of beryllium by deuterons is shown are detailed and complete enough for any group of students in x-ray physics.

The theoretical pathways of ions struck off after collision of a neutron with an atomic nucleus are clearly drawn, the composition of body tissues in terms of the elements which may be fitted into these schematic representations is considered, and even if one is not able to maintain his orientation while threading the mazes of Greek letter formulae such as physicists and astronomers use, he may still gain a worth while comprehension of the principles elucidated.

The formation of radioactive substances by neutron bombardment is fully considered and their possible therapeutic applications are discussed.

The description of the betatron is the clearest this abstractor has read. The author contrasts this instrument in several respects with the cyclotron thereby elucidating the operation of each. One effect of the rays generated at betatron voltage is surprising and very interesting according to present computations, the depth dose at 2 cm will be about 200 per cent at ten million volts; at fifteen million volts the maximum will be found at 3 cm and will exceed 250 per cent; at ten million volts and at 10 cm depth the dose is expected to be about 500 per cent. The author points out however that the biologic phenomena cannot be anticipated but must be observed and that for this reason one should not be overimpressed by depth dose calculations. The atomic bomb is briefly mentioned.

Percy J. DELANO, M.D.

Cancer in Childhood. I. G. Williams *Brit J Radiol* 19 182-197, May 1946

The incidence of cancer in childhood as given by various authors ranges from 0.055 to 1.8 per cent. As a cause of death in children the disease assumes significant proportions. In 1939 the death rates for children under 15 in Massachusetts were 4.2 from cancer, 4.0 from pertussis, 2.7 from tuberculosis, and 1.3 from measles. Sarcoma is nine times as frequent as carcinoma in this younger group. In the British mortality tables cancer was not found under twenty-five years of age in the following sites: lip, tongue, mouth, esophagus, small or large bowel, rectum, gallbladder, pancreas, larynx, prostate, penis, scrotum, vulva, and vagina. The commonest sites are the kidneys and suprarenals, eyes, glands [lymph nodes?], muscle, bones, brain, and meninges, in the order given. After fifteen years there is a decrease in the incidence of tumors of the kidneys and brain.

In the series reviewed, numbering 181 patients, 8.3 per cent of the lesions were carcinoma and 91.7 sarcoma. Five of 15 patients with malignant epithelial tumors were alive and well, two having lived longer than five years. Of the 160 patients with sarcoma, 50 were alive and free of recurrence following treatment, 10 of these having passed the five-year period.

Surgical excision was the sole method of treatment in 37 cases comprising parotid tumors, osteoclastoma, retinal glioma (excision of the eye), Wilm's tumor (nephrectomy), carcinoma of the breast, testicular tumors, ovarian carcinoma, and cerebral tumors. The operative mortality was 8.1 per cent.

Combined surgical removal and radiation was used in 66 cases, irradiation being done postoperatively. Radiation alone was used in 60 cases. The tolerance of the patient is limited by local tissue reactions and the constitutional response.

Because the normal tissues of children are actively growing, the difference between the lethal radiation dose for the cancer and for normal tissues is less than with adults. Accurate figures for the tolerance of the normal tissues are not available for different age groups. In general, infants tolerate 25 per cent of the adult dose and children 50 per cent. Where opposite parallel fields are used, the exit dose may be of significant proportions. The mucous membranes in children are closer to the surface than in adults and so will receive a relatively higher dose. The following general rules

were followed small daily doses (100 to 150 r with back scatter), no radiation on two days out of every seven, no patient under ten years given enough to cause a moist desquamation, patients over ten given 90 per cent and sometimes the full adult dose

Constitutional effects of radiation are the same in children as in adults. Because of the closeness of the mucosa to the surface as mentioned above, gastrointestinal disturbances are more apt to occur. A drop in the red and white cell counts may occur more suddenly and to a greater extent than with adults. Interference with bone growth may follow irradiation.

Several tables supply details of the cases constituting the series
SYDNEY J. HAWLEY, M.D.

Cutaneous Cancer from the Point of View of the Radiologist. William Harris. *Arch. Dermat. & Syph.* 53: 586-587, June 1946

Among the indications which will determine the type of treatment in cancer of the skin the author mentions the life expectancy of the individual, location of the lesion and whether or not it involves cartilage or bone, the nature of the tumor bed, presence of scar tissue, and previous treatment. In persons whose life expectancy is short, cure is often sacrificed for palliative effect and thus radiation is used rather than surgery.

Cancers of the scalp and extremities and those resulting from a ray burn and in other burn scars are best treated by surgery. The management of metastatic lymph nodes is also usually a surgical problem although palliation and possibly cure may be obtained by radiologic means.

For single lesions up to 0.5 cm in diameter one treatment of 3,000 to 3,600 r is used. For larger lesions the dose is five times 900 r (80 to 100 kv) given in ten days. With contact therapy (45 kv, 1.2 mm Al filter, 4.1 cm focus-skin distance) six times 1,000 r is the dose. With this technique the rate of cure is over 90 per cent in cases not previously treated.

The invasion of cartilage is not a contraindication to radiotherapy and there is no advantage in electrocoagulation or desiccation of the lesion before roentgen ray therapy. The author insists on lead cut-outs leaving 0.5 cm of healthy tissue around the lesion as a necessity for a high percentage of cure.

JOSEPH T. DANZER, M.D.

Treatment of Cutaneous Epithelioma. George T. Pack. *Arch. Dermat. & Syph.* 53: 578-585, June 1946

There are no hard and fast rules in the treatment of epithelioma. A knowledge of the peculiarities of behavior of the various types of cancer, the limitations which the location of the cancer imposes and the advantages and disadvantages of each method of treatment are essential in obtaining a good result.

High-voltage roentgen rays (200 kv or more) are seldom used except for deeply infiltrating epitheliomas. As it is impossible to sterilize metastatic epidermoid carcinoma in lymph nodes by high voltage irradiation alone, it must be supplemented by interstitial irradiation or surgical dissection.

Low-voltage roentgen rays (100 to 140 kv, 30 to 40 cm target-skin distance without filter or with 1.0 or 2.0 mm Al, according to the thickness of the lesion) are of great value in the treatment of cutaneous cancer. The skin surrounding the lesion is shielded by 0.5 mm. The lesions are treated by daily to 1.0 mm of lead. The lesions are treated by daily fractional doses of 250 to 350 r until a total dose of from

2,500 to 4,000 r is given. When small ports or cones are used there is little back scatter, consequently the smaller the area the greater the irradiation required for a satisfactory result.

The Chaoul contact and Philips contact roentgen ray therapy outfits are limited to a voltage of 50 to 60 kv. They operate at contact or at 3 to 5 cm target-skin distance. For contact irradiation the output is about 800 r per minute, daily fractional doses of from 250 to 400 r are usually given to total from 3,000 to 8,000 r. The advantage of such apparatus is that most of the irradiation is absorbed by the tumor proper, leaving the deeper structures unharmed.

There are four standard radium applicators in general use at Memorial Hospital (New York). Their filtration is equivalent to 3 mm of brass. They are applied at a distance of 1 to 3 cm and their use is limited to superficial lesions. All epitheliomas which are more than 1 cm thick and are more than 3 cm in diameter should be treated by low voltage roentgen therapy.

Whenever contact application of radium is desired over irregular surfaces a moulage of dental modeling wax may be used in which radium tubes with 0.2 to 0.5 mm platinum filtration are imbedded. The dose is computed on the basis of 75 to 100 millicurie hours per square centimeter treated. Penetration of the radiating beam is very little and if the cancer is more than 5 mm in thickness supplementary interstitial irradiation should be employed or the radon or radium tubes should be implanted more deeply into the moulage to give a greater depth dose.

Radon seeds, 4 mm long and containing 1 to 3 millicuries, find their chief application in the treatment of lesions of the ear, eyelid and face. Care must be taken not to insert the seeds too near cartilage or a painful perichondritis may follow.

Radon bulbs containing 300 to 600 millicuries of radon may be used for keratoses and small basal-cell epitheliomas, 200 to 600 millicurie minutes being given.

The author discusses the factors influencing treatment under five headings:

(1) *Location of Cancer.* A cancer in close proximity to bone or cartilage should be treated surgically. Any tissue that is difficult to restore by plastic reconstruction should be treated by low voltage irradiation. The eyelids are best treated by low-voltage irradiation with care to shield the eyeball to prevent cataract or iridocyclitis. The nose is also best treated by low-voltage therapy, the dosage being measured carefully to prevent a perichondritis or chondritis. For the ear and auditory canal low voltage irradiation or contact radium by a moulage is preferred unless the cartilage is largely destroyed. The superficial insertion of gold radon seeds is used for cancers of the external auditory meatus. The skin over bony prominences of the hands and feet is poorly nourished and for this reason irradiation is not indicated in these locations. The only possible exception is when an epithelioma on the dorsum of the hand or foot is not of great thickness in which event radium or low-voltage roentgen therapy may be used. Cancers of the sole of the foot should be treated by surgical excision as the skin will not tolerate injuries or weight bearing after irradiation. Late radionecrosis or recurrence often follows irradiation therapy of tumors of the scalp.

(2) *Type and Stage of Cancer.* The factors of fixation and infiltration are more important than histologic grading. In general small basal-cell epitheliomas are

best treated by irradiation. Spindle cell metaplasia of epidermoid carcinoma is so radioresistant that the surrounding tissue will slough from over irradiation while the cancer cells still remain viable. A papillary carcinoma covering extensive areas should be removed by surgical endothermy and the base irradiated by fractional roentgen ray therapy. Fixation is a contraindication to radiotherapy.

(3) *Recurrences* When a cancer of the skin recurs after irradiation, further irradiation as a rule, is not indicated. There is usually a loss of sensitivity and the surrounding tissue is more prone to radiation ulceration. If the recurrence is small, it may be treated by radon seeds.

(4) *Selection of Treatment of Cancers of Certain Types and Origins* Bowen's disease should be considered a true carcinoma and the treatment should be the same as for squamous-cell carcinoma. Paget's disease should be treated as a carcinoma of the breast, with amputation. Cancer in acrodermatitis chronica atrophicans, xeroderma pigmentosum, lupus vulgaris, burns and scars and in chronic radiation dermatitis should be treated by excision. When a cancer appears in a draining sinus an attempt must be made to clear up the sinus. Therapy may then be given by the divided dose technique.

(5) *Treatment of Metastatic Carcinoma in Regional Lymph Nodes* Radiation therapy alone cannot cure metastatic squamous or spindle cell carcinoma. If the case is operable, dissection of regional lymph nodes should be complete. The factors for palliative irradiation therapy are 200 kv, 0.5 mm Cu and 1.0 mm Al, 50 cm target skin distance. Fractional doses are given daily—200 to 300 r until each port has received 2,000 to 3,600 r. JOSEPH T. DANZER, M.D.

Radiotherapy of Epithelioma of the Skin. Maurice Lenz. Arch Dermat & Syph 53: 588-596, June 1946.

Treatment of epithelioma of the skin by roentgen rays and radium is influenced by the accessibility of the growth and by its radiosensitivity. Most tumors of the skin are accessible to irradiation—98 per cent of basal-cell and 75 per cent of squamous-cell epitheliomas are located on the head and neck. Their curability decreases with the increase in size of the growth. The importance of radiosensitivity is best appreciated in the treatment of extensive epitheliomas as smaller lesions are frequently over-irradiated and destroyed irrespective of their inherent radiosensitivity. Adenocarcinomas and adenocystic epitheliomas arising in sweat glands are generally radioresistant and are best treated by surgery.

The radioresistance of the tumor bed is poor in poorly vascularized tissue; therefore carcinomas arising in scar tissue should be treated surgically. Radiation damage to the tumor and the normal surrounding tissue is proportional to the amount of radiation and inversely proportional to the duration of treatment. The shorter the natural life cycle of the tissue irradiated the sooner will the radiation damage be recognizable. Thus mucous membranes will die and desquamate a few weeks after exposure but bone and connective tissue may not show irradiation damage for months. Osteitis or chondritis may develop from over irradiation of lesions of the ear, nose and scalp.

Metastasis to lymph nodes decreases the chance of cure from 54 per cent to 18 per cent. Surgery is preferable if the nodes are freely movable. Roentgen

therapy or the insertion of radium or radon seeds is preferable if the nodes are fixed.

The type of irradiation to be employed is influenced by the location and extent of the lesion, the radioresistance of the tumor bed, the blood supply, and the condition of the patient. Invasive epitheliomas may show a tiny surface tumor and a wide subsurface extension.

In contact roentgen therapy of superficial epitheliomas the target skin distance is 1.8 to 4.1 cm, with no filter. For deeper epitheliomas 15 to 30 cm target-skin distance is used, with 100 to 135 kv and 3.0 mm Al filter. For extensive lesions 130 to 200 kv and 0.5 mm Cu filter are usually preferred. In external radium therapy the target skin distance is from 0.7 to 1.0 cm, in telerradium therapy from 6.0 to 14.0 cm.

If one hopes to cure an epithelioma, a single irradiation treatment is given by one or a series of exposures. If a cure is not expected, weak radiation intensities are repeated from time to time. A cancericidal dose for each variety of epithelioma has not been adequately determined. Whatever technique has been employed correct irradiation should produce wet desquamation of the irradiated epidermis leaving a denuded, raw, bleeding corium. The speed with which healing takes place depends on the size of the denuded area and the damage to underlying blood vessels.

In contact therapy, a single massive dose of 6,000 to 12,000 r may be given to superficial lesions 1.0 or 2.0 cm in diameter and good healing may result. Satisfactory results have also been obtained with 3,000 r (100 kv, 15 cm target-skin distance) in basal-cell epitheliomas 1.0 cm in diameter, 4,000 to 6,000 r, with doses of 250 r or 500 r every other day, leaves a better scar and is more effective. With 130 to 200 kv, smaller daily doses are given.

In external radium mold therapy, 4,500 to 7,000 r of gamma radiation are usually given. In interstitial therapy 4,000 to 7,000 r of gamma rays are given in from five to ten days.

As far as curability of the average epithelioma is concerned it is immaterial whether one uses radiotherapy or surgical intervention, provided adequate treatment is applied to all cancer cells. Success depends on the appreciation of the extent of the growth and its adequate treatment during the first and only treatment.

JOSEPH T. DANZER, M.D.

Symposium Malignant Melanoma. P. J. Moir, E. K. Dawson, Margaret C. Tod, Georgiana M. Bonser, I. G. Williams, and Frank Ellis. Brit J Radiol 19: 217-232, June 1946.

In his introduction to this symposium, Moir points out that in man pigment-containing cells are found in the skin eye and certain parts of the central nervous system. He classifies pigmented tumors as benign moles (congenital or acquired) and malignant melanoma. Between 65 and 80 per cent of malignant melanoma occur in pre-existing benign tumors or moles. Irritation is an important factor in the development of malignancy. The evidence of malignant change consists in a sudden increase in size, ulceration, bleeding, or the appearance of satellite tumors. Metastasis occurs early by both lymphatics and the blood stream. This may be explained by the fact that these tumors contain wandering phagocytic melanophores as well as fixed pigment-bearing cells. Because of the danger of metastasis biopsy should not be done unless the lesion

is widely excised. Questionable lesions are better left alone.

Moir considers extensive surgical removal with block dissection of the regional lymph nodes the best treatment for malignant melanoma if the lesion is thought to be operable at all, and the other contributors to the symposium are in agreement with this view.

Tod reports a series of 107 cases of malignant melanoma (not all histologically proved), of which 23 had been treated radiologically at least five years earlier. There were 6 five-year survivals of this small group. She warns against radium implantation except in the orbit, because of the trauma involved. Treatment by irradiation should always be by surface application and handling must be reduced to a minimum. After either radium mold or x-ray therapy, any sign of recurrence calls for immediate surgical removal.

Ellis, while admitting that in clinical practice complete proof that a malignant melanoma can be cured by radiation is rarely possible, believes that some of the lesions are undoubtedly radiosensitive. He presents results in 53 cases from the Sheffield Radium Centre, with four survivals of more than five years, though in no instance was there rigid proof of cure of a histologically proved melanoma.

Other points made in the course of the symposium include the following: Routine postoperative irradiation is not advisable for skin lesions. It is better to save the radiation for use to the limit of tolerance in known recurrences and metastases. Lesions on the head and neck give the best result probably because the more conspicuous position leads to earlier treatment. The disease is more certainly and rapidly fatal in younger subjects. SYDNEY J. HAWLEY, M.D.

Carcinoma of the Lip and Its Treatment by Radium (1928-44). Alexander A. Charteris. *Brit. M. J.* 1 719-721, May 11, 1946.

During the seventeen-year period, 1928-44 inclusive, 293 cases of cancer of the lip were seen at the Radium Department of the Western Infirmary, Glasgow. Forty-seven patients were not treated by radium for various reasons. The 246 cancers treated were not a selected group but included growths in all stages with and without invasion of the lymph nodes and some extending beyond the actual lip area. In the cases showing eventual failure, this was obvious by the end of the first year with but 7 exceptions and for that reason all cases are included up to the year 1944, save 4 cases treated late in 1944 in which the outcome was doubtful. A total of 242 cases is thus left for analysis. All but 8 patients were males. In all but 8 cases the primary lesion involved the lower lip; a secondary primary lesion subsequently appeared on the other lip in one upper lip and two lower lip cases. Thirty-four patients had secondary involvement of the lymph nodes when first seen, of the 208 cases with no obvious involvement of the cervical nodes, although the neck was not treated, only 19 (about 9 per cent) had cervical metastases at a later date. The policy with lip cancers has therefore been to treat the primary growth and rely upon the routine follow up to detect any regional metastases. Surgery and implantation of radium show the greatest promise in the treatment of cervical nodes.

Implantation of radium was carried out in 120 patients without lymph node involvement, 117 of these (97 per cent) were free of disease at the time of the report. In 6 of this number a residue or small recurrence

had been excised. The needles employed for implantation have a linear intensity of 0.6 mg of radium element per cm of active length, those with a total length of 41 mm (2 mg Ra el) and 32.7 mm (1.2 mg Ra el) have proved most useful. Two common arrangements were a 4.5 × 2-cm rectangle (three 2 mg Ra el closed at each end by a 1.2-mg needle) and a 5.5 × 2-cm rectangle (six 1.2 mg needles in tandem pairs closed at each end by a needle of the same strength). The strength of each line is uniform so that the dose rate rises toward the center of the area, but the results from every point of view have proved so good that no adjustment has been made. The dose delivered 0.5 cm from the needle plane in 168 hours varies between about 5,000 r and 6,000 r with a maximum of 6,700 r toward the center. At the extreme corners of the rectangles the dose falls to about 4,000 r but with the margin provided this part is not in the tumor zone.

Fifty-five patients without regional metastases were treated with double radium molds. Forty-eight (87 per cent) were free from disease at the time of the report, 3 having had excision of residual tumor or small recurrences. A dental apparatus is used in a form suitable for irradiating the inner and outer surfaces of the lip simultaneously. With a radium-mucosa distance of 0.5 cm and radium-skin distance of 1.0 cm, about 6,000 r is given throughout the lip, the mucosal dose is higher than this, but no untoward results have ensued.

In 14 patients without involvement of the nodes, the cancer was first excised and radium then applied. There was one failure in this group.

Among the 34 patients with regional metastases when first seen there were 19 failures and among the 19 with secondary involvement developing after successful treatment of the cancer of the lip, there were 9 failures.

Sixty-seven patients showed some definite evidence of scarring with or without telangiectases, following irradiation. Actual tissue damage in the form of late necrotic ulcers was seen in 6 patients, but 4 of these were treated in 1929-31 when no physical control was possible. Five of these had been treated by implantation. Healing occurred in all with some scarring. In no instance did the necrotic lesion exceed 1.0 cm in diameter, and the lip was never perforated.

Cancer of the Larynx and Pharynx. Results of Radiation Therapy at Charity Hospital. Manuel Garcia, Joseph V. Schlosser, and Joseph B. Marino. *New Orleans M. & S. J.* 98:483-489, May 1946.

The authors review the results of radiation therapy in 88 histologically proved cases of a series of 104 cancers of the larynx and pharynx seen by them in the Charity Hospital, New Orleans, in the years 1939 to 1942 inclusive. All but 3 of the 88 patients were traced. Those lost to follow up were counted as dead, and those who refused treatment or were too ill to receive it were considered as radiation failures. The results thus represent the minimum accomplishment of radiation therapy in consecutive cases demonstrated histologically.

Topographically the lesions were distributed as follows: rhinopharynx 6, soft palate 12, tonsil 14, vallecula and base of tongue 13, aryepiglottic fold 7, piriform sinus 6, lateral and posterior walls of pharynx 10, ventricular band 7, ventricle 1, vocal cord 11, subglottic region 1. Symptoms were dependent upon the site. Severe constitutional effects with loss of weight, anemia, and fever from tumor sepsis or pul-

monary complications were present in many of the cases when first seen

The authors believe that these patients should have as complete a diagnostic survey as possible to provide a sound basis for a rational plan of treatment. They recommend particularly laminagraphy combined with lateral roentgenography to determine the extent of involvement.

The presence and extent of cervical metastases affect the chances of recovery in a decisive manner. In this series, 43 per cent of the patients had metastases on admission, and in others they developed subsequently, so that a total of 57 per cent had metastatic involvement at some time in the period of observation. No radical dissections were performed. The percentage of salvage in this advanced group is smaller than in cases more suitable for surgical treatment but of 19 patients with metastases treated over five years earlier, 3 remained well.

Irradiation is by the Coutard technic (protracted fractionation). This, the authors warn, must be considered a radical therapeutic procedure not to be undertaken without careful study and preparation of the patient. The tolerance of the normal structures must be reached. Sharp reactions must be obtained and the discomfort may be so pronounced as to affect the patient's general condition. The main factors to be taken into consideration are the volume of tissue to be subjected to high dosage and the rate of administration of treatment. With careful study of the physical problem and continuous clinical observation, the treatment can be executed with little risk of serious injury. The authors have aimed at delivering a tumor dose of 4 400 r \pm 10 per cent in a period of thirty days when the area of treatment ports does not exceed 50 sq cm. A somewhat lower dose must be used with larger areas. In some locations notably the rhinopharynx, intracavitary radium therapy may advantageously supplement roentgen therapy. Interstitial radium implants may also be helpful in carcinomas of the vallecula, the base of the tongue, the tonsil, and metastatic cervical nodes. The implant is done in a single or double plane and the tissue dosage is between 3 000 and 6 000 gamma roentgens.

All cases included in the series studied were inoperable either for technical or clinical reasons. The overall survival rate was 24 per cent at three years. Patients with lesions of different histologic type showed varying survival rates but the authors felt that the number of cases involved was too small to make the variations significant. The more immature carcinomas showed a better result and adenocarcinomas responded well to treatment indicating that they are not necessarily radioresistant. No significant racial differences were noted. Better results were observed in women though they represented less than one sixth of the total number of cases. Patients with no metastases at any time showed 36 per cent three year cures while those with metastases on admission showed only 13 per cent.

Only 77 of the patients completed the treatment course. None of the others survived as long as one year and the same is true of those who did not obtain primary healing whether with full or incomplete treatment.

It is believed by the authors that in unselected material, only about 60 per cent receive tangible benefit in the form of freedom from symptoms and longer survival with present methods of treatment. They believe it is

important to establish objective criteria for judging suitability for radiation therapy before it is instituted, similar in nature to the criteria of operability. So far, no facts have been elicited which would enable them to foretell the response to radiation therapy in a given case. The factors most suggestive of a favorable response are limited anatomic involvement, preservation of mobility of normal parts, and a papillary architecture of the tumor. Good results have been obtained, however, in the absence of all these criteria, and every patient should be given the benefit of a trial of radiation, at least until more definite criteria for selection are established.

Once primary healing had been achieved, late failures occurred as the result of local recurrence in 34 per cent of the patients, as a result of metastases in 22 per cent, and of intercurrent disease in 4 per cent, while 40 per cent remained alive and well at the end of three years. In regard to localization of the disease, 31 per cent of 32 patients with upper pharyngeal involvement survived three years, 11 per cent with lower pharyngeal involvement, and 35 per cent with endolaryngeal involvement. These results are similar to those obtained elsewhere. Among 47 cases observed over five years, the corresponding percentages were 28, 7, and 21. The low survival rate with involvement of the lower pharynx indicates the need for improvement in the method of treating those cases.

BERNARD S. KALAYJIAN, M.D.

Cancer of the Breast. Statistical Report of Results. Donald V. Trueblood. *West J Surg* 54: 217-227, June 1946.

This report is based on 65 breast carcinomas all treated surgically. No preoperative or postoperative radiation therapy was used. The author does not believe that sufficient radiation can be given to eradicate the disease and then, too, he believes there is too long a delay following irradiation before surgery can be done. As to postoperative irradiation, if surgery has been complete this is not indicated, if cancer remains, its location cannot be determined and radiation cannot be given in sufficient amounts to the entire field.

Forty-four (67.7 per cent) of the author's 65 patients survived four years or more, of 26 without axillary involvement 23 (88 per cent) survived five years, of 38 with axillary involvement 50 per cent survived for five years.

MAURICE D. SACHS, M.D.

Evolution of Radiotherapy with Radioactive Substances for Carcinoma of the Breast. V. Palumbo. *Radiodosimetry—Radium Therapy with Molds in Carcinoma of the Breast (Note 2)*. M. Paoletti. *Arch di radiol (Naples)* 18: 157-187, July-October 1942.

After a review of the literature on the value of preoperative and postoperative radiotherapy for carcinoma of the breast, the authors present charts showing the distribution of energy in the breast and its lymph-drainage areas by their technic of surface application of radium and x-rays and describe the clinical doses they have given to 111 Stage 2 cases. By this combined method they obtained satisfactory results, that is, a five-year survival rate of 61.2 per cent, a six-year survival rate of 45.4 per cent, and seven-year survival rate of 31.5 per cent. The indications, contraindications, technic and skin reactions are discussed in some detail.

E. T. LEDDY, M.D.

Prognosis and Problems in Renal Tumors Clyde L Deming J Urol 55 571-582, June 1946

The author discusses the prognosis and problems associated with renal neoplasm and reports a series of 82 cases which were carefully followed

In general 95 per cent of renal tumors are malignant The usual five-year survival is 20 per cent but it is to be noted that many will die of metastasis before a second five years has elapsed

In the author's series of 82 cases only one was lost from follow up and that after a survival of over ten years It was noted that two periods of life showed a relatively high incidence of renal tumors, the first decade and the later decades 13 4 per cent of the 82 cases were in the one to ten year age group It was also noted that 72 per cent of the tumors occurred in males and that in two-thirds of the cases the right kidney was affected Since he considers the terminology of renal tumors chaotic, the author has not classified his cases on a pathologic basis His results were comparable with the generally reported results At the end of five years 19 5 per cent were living At the end of ten years 14 6 per cent were living but only 9 08 per cent were free from metastasis

The use of irradiation is discussed but no definite conclusion is reached Certainly," the author writes, "x ray irradiation should never be given until a histological diagnosis is made and then with reservation So far we have no specific means to designate radiosensitive and radioresistant renal tumors"

FREDERICK A BAVENDAM, M D

Roentgen Therapy for Malignant Teratoma of the Testis Raymond J Scheetz and Eugene T Leddy Am J Roentgenol 55 754-764, June 1946

There has been considerable confusion in the literature regarding testicular tumors because of differences in classification Some believe that all of the common tumors of the testis are teratomatous in origin Others feel that seminoma at least, is a different and distinct entity The authors, following Broders classification adhere to the latter view They point out that the tendency when computing survival rate to group all varieties of tumors of the testis together, has made it impossible to determine to what extent irradiation has been of value in each variety

This report is based on 54 cases of histologically verified malignant teratoma of the testis The incidence etiology pathology site of tumor symptoms diagnosis and therapy are discussed The maximal incidence of teratoma occurs earlier in life than that of seminoma Ninety three per cent of the patients were between fifteen and thirty nine years of age A painless swelling of the testis was the most frequent initial symptom Pain was the prominent symptom in 16 cases The most frequent sites of metastasis were the para-aortic lymph nodes supraclavicular nodes peribronchial lymph nodes inguinal lymph nodes and skeleton

Tests for urinary gonadotropin were not used and are considered to be of decidedly limited value Histologic examination affords the only means of accurate diagnosis The authors favor immediate surgical excision of the tumor on diagnosis rather than the use of preoperative roentgen therapy

The results obtained in 36 of the authors' cases are analyzed In 17 of these cases treatment was begun

when there was no evidence of metastasis It consisted in simple orchiectomy and postoperative roentgen therapy Eight patients lived five or more years after operation Of the remaining patients who had clinical evidence of metastasis when treatment was begun none was alive after five years Only one of these lived three or more years after operation (40 months) and roentgen therapy was not begun on this patient until 32 months after orchiectomy The dosage and method of application of the roentgen therapy are not stated

The authors conclude that roentgen therapy does not appear to have any beneficial effects on malignant teratoma of the testis H H WRIGHT M D

A Case of Sarcoma of Bone Treated by Radiotherapy Gwen Hilton and L E Glynn Brit J Radiol 19 198-202, May 1946

An interesting case is reported of an osteogenic sarcoma in the femur of a man twenty six years of age with treatment by radiation only The patient sustained a fracture of this femur in an air raid ten years later As the fracture failed to unite the leg was amputated Examination of the amputated limb showed the cortical bone to be thinned The endosteal surface was extremely roughened There were pseudo-cysts filled with white gelatinous material in the cancellous bone of the head and the greater trochanter The medullary cavity was filled with a rich network of hard bone, the interstices of which contained opaque white fibrous tissue The cortex distal to the fracture was perforated in several places, the perforations filled with opaque white, dry crumbly material

Microscopic examination showed the cortical bone to be replaced by a layer of close meshed cancellous bone with loose moderately cellular and vascular fibrous tissue filling the marrow spaces The haversian system was present but the marginal lamellae were completely absent Some of the haversian canals were filled by basophil lamellae indicative of a sclerosing process The periosteum was virtually acellular and avascular Many of the bone lacunae were swollen and empty The medullary cavity was filled with an elaborate network of spongy bone with the interstices containing poorly cellular and poorly vascular connective tissue There was no osteoblastic nor osteoclastic activity but many trabeculae were undergoing an apparently acellular central disintegration and surface erosion There was no evidence of sarcoma

SIDNEY J HAWLEY M D

Roentgen Therapy of Benign Giant Cell Tumor of Bone Simeon T Cantril and Franz Buschke West J Surg 54 250-264 June 1946

The authors report two cases of giant cell tumor of bone which responded excellently to irradiation They consider roentgen therapy of such tumors highly satisfactory Surgery should be considered only if the resection is to extend beyond the tumor area or if it will expedite the end results as in the head of the fibula Curettage is unsatisfactory because of recurrence and danger of infection The main problem in giant-cell tumors is the correct roentgen diagnosis (biopsy should not be necessary) and avoidance of over irradiation Therapy should be given in such a way that a minimal lethal tumor dose is delivered without interfering with bone regeneration MAURICE D SACHS M D

Leukosarcoma Franklin B Bogart Am J Roentgenol 55 743-753, June 1946

Under the title "Leukosarcomatosis" Sternberg in 1908 described a group of cases characterized by marked mediastinal enlargement, including the thymus gland, and a terminal blood picture usually classified as an acute lymphatic leukemia. Other features of the condition are enlarged superficial lymph nodes and lymphoblastic infiltration of various organs of the body, particularly the thymus, liver, spleen, and kidneys. Biopsy of a lymph node is usually reported as showing lymphosarcoma. At the onset of symptoms the blood picture may be normal. The predominant blood cell in the terminal phase is usually described as a lymphoblast. Isaacs believes that the cell is a characteristic one which can be differentiated by staining properties, and he designates it as a leukosarcoma cell. Some authors include cases in which the predominant involvement is elsewhere than in the mediastinum.

Respiratory distress is frequently the first symptom. Other symptoms reported are malaise, weight loss, slight elevation of temperature, bleeding, joint pain, herpes toxic erythema multiforme, diplopia, and local edema.

The mediastinal tumors are markedly radiosensitive and roentgen therapy is indicated when there is circulatory or respiratory distress. Prompt reduction in the size of the tumor and relief of the distress may be obtained after administration of 200 r to 400 r, but roentgen therapy does not influence the ultimate course of the disease, which usually terminates fatally in a few weeks to a few months.

The author reports in detail two cases which conform to Sternberg's description of leukosarcoma. The reports include the clinical, laboratory, roentgenologic, and autopsy findings. The first patient received no roentgen therapy. The second received roentgen therapy to the mediastinum with dramatic relief of respiratory symptoms but survived for only a short period of time. In both patients a leukemic blood picture appeared before death, indicating that roentgen therapy is not the cause of change from a normal to a leukemic blood picture in these cases.

H H WRIGHT, M D

Leukaemia Treated with Urethane Compared with Deep X-Ray Therapy Edith Paterson, Alexander Haddow, Inez Ap Thomas and Jean M Watkinson Lancet 1 677-682 May 11, 1946

Urethane (ethylcarbamate) was used in 32 cases of leukemia (19 myeloid, 13 lymphatic) and the patients were observed over periods ranging from five weeks to eleven months. The condition of 15 of the patients was considerably improved. 7 of this number received urethane only, the others also had some x-ray therapy. In 9 cases there was some improvement but it was not considered satisfactory, 5 of these patients received urethane only. Of the 8 patients who died, only one had received x-ray therapy. Six of the 32 patients had blood transfusions. For purposes of comparison, a group of 31 patients with myeloid leukemia and 14 with lymphatic leukemia treated by x-ray therapy were studied. The effects of urethane and of deep x-ray therapy are strikingly similar. In the favorable cases there was a fall in the total white-cell count to normal limits with a tendency for the differential count to approach a more normal pattern, diminution in the size of the spleen and enlarged lymph nodes, and a rise in the

hemoglobin level. There is no indication that permanent benefit may result from the use of urethane in either myeloid or lymphatic leukemia, for relapses take place and immature cells may reappear in the blood. The cases are too recent to enable any statement to be made about the effect of treatment on length of life. The palliative effect, however, in many cases was great. Because oral administration of urethane produced nausea and vomiting in a considerable number of cases the drug was given by rectum.

Urethane was also administered in 13 cases of advanced cancer of the breast and 11 cases of lymphosarcoma, Hodgkin's disease, and recurrent mixed salivary tumor of the antrum. A moderate leukopenia was observed in 9 of these. In 3 of the breast cases and 4 of the miscellaneous group there was a temporary diminution in the size of the lesions.

NON-NEOPLASTIC DISEASE

Treatment of Rheumatic Fever by Roentgen-Ray Irradiation Geo C Griffith and E P Halley Ann Int Med 24 1039-1042, June 1946

Two hundred and one patients, all of whom had a well established rheumatic fever of six months or more duration, were studied in the Rheumatic Fever Unit, at the U S Naval Hospital, Corona, Calif. Before roentgen therapy was instituted, a careful evaluation of the history, physical findings, and laboratory studies was made for each patient. A similar evaluation was made at the end of twelve weeks, and 42 patients were again evaluated at the end of twenty-six weeks. Weekly electrocardiograms and blood sedimentation rates were recorded.

The 201 patients were divided into three groups on the basis of treatment, but neither the roentgenologist, the clinicians, or the patient knew in which group any individual was placed by the technician. Group A received 100 r through the myocardium at weekly intervals for five successive weeks. Group B received 100 r through the myocardium and over the middle and lower cervical sympathetic ganglia at similar intervals. Group C went through the same mechanical routine but a lead filter was used to block out the roentgen rays, so that no radiation was received. Neither after twelve weeks nor after twenty-six weeks were any significant differences observed in the three groups, from which it is concluded that roentgen therapy is not a useful procedure in rheumatic fever.

Levy and Golden had previously published several reports on roentgen therapy in rheumatic heart disease to which the authors refer (see Absts in Radiology 10 524, 1928, 13 282, 1929, 22 385 1934) in which it was stated that the best results were obtained in patients treated during the primary attack but this observation was not confirmed in the present series.

In a letter published in *Annals of Internal Medicine* in August 1946, Levy and Golden defend their thesis that roentgen therapy has a place in the treatment of rheumatic heart disease. In explanation of the discrepancies between their results and those of Griffith and Halley, they cite the difference in technique of irradiation and the different emphasis in the two studies. Their attention was focused upon the heart, while Griffith and Halley appear to have been chiefly concerned with the general manifestations of rheumatic fever. Levy and Golden refer to their latest paper (Am J M Sc 194

597, 1937 Abst in Radiology 30 776 1938), which was not mentioned by Griffith and Halley and repeat some of the conclusions contained therein

STEPHEN N TAGER, M D

Roentgen Therapy for Rheumatic Diseases Richard H Freyberg M Clin North America 30 603-615, May 1946

Two representative cases of spondylitis rhizomélisque treated by roentgen irradiation are presented. The first patient, age 21, was given three courses of irradiation, with excellent results. Five ports over the spine were used, two measuring 12×14 cm, one 16×14 cm, and two 18×10 cm (a diagram is reproduced to show the location of the fields). X ray factors were 200 kv (175 kv constant potential equivalent), 0.5 mm Cu and 1.0 mm Al filtration, h v l 0.9 mm Cu, 50 cm skin-target distance, and an output of 50 r (measured in air) per minute. Three ports were irradiated on the first, third, and fifth days, and two on the second, fourth, and seventh days, for a total of 600 r to each portal.

In the second case of spondylitis, the number of ports was reduced to four, but the width of the fields was increased so that more of the spinous tissue was irradiated (one field 12×18 cm, two 18×16 cm, and one 14×12 cm) and a lower voltage was used. Factors were 140 kv, 10 ma, skin target distance 50 cm, filters 0.5 Cu and 1.0 mm Al. Each port received 450 r ($150 \text{ r} \times 3$). This patient received two courses of irradiation. This technic was equally successful in relieving the pain and stiffness, and radiation sickness has been found to be less frequent following its use.

Thiamine hydrochloride is not given routinely during treatment but is administered if severe anorexia or nausea occurs. Pyridoxine has been found useful in relieving gastro-intestinal symptoms.

Contrary to the experience of some others, the author has found roentgen irradiation of little value in rheumatoid arthritis. Some patients with osteoarthritis obtain slight temporary relief from pain but in most instances no subjective or objective benefit is noted. Approximately 50 per cent of patients with non articular rheumatism were not helped.

The author concludes that roentgen irradiation should be considered as part of the therapeutic program for certain forms of arthritis but should be wisely administered, with an understanding of its limitations.

Aerotitis Media in Submariners Henry L Haines and J Donald Harris Ann Otol, Rhin & Laryng 55 347-371 June 1946

In order to obtain further light on the causes and effects of aerotitis media and to discover if possible means of prediction, prevention and treatment, 6149 men were submitted to 50 pounds air pressure in a submarine escape training tank. Of this number 26.9 per cent contracted otitis media. These men were then assigned to various experimental groups to determine the effect of certain forms of therapy in preventing the development of subsequent attacks under pressure. Among the measures tried were roentgen and radium therapy. The roentgen therapy experiments, however had to be discontinued for administrative reasons so that no conclusions as to its effect could be reached.

For radium therapy a random sample was selected from those patients with excessive lymphoid tissue in and about the pharyngeal ostium. Fifty milligrams of

radium salt was applied for eight to ten minutes. The radium was contained in a monel metal applicator 2 cm long with an inside diameter of 1.7 mm and walls 0.3 mm thick. This cylinder was brazed to a wire by which it was handled. Crowe's and Burnam's technic was followed. Successive radium treatments were given at intervals of about a month. One group was required to take a pressure test after every treatment, while another group was required to wait until a course of three to eight treatments was completed.

About 90 per cent of the 732 patients receiving radium therapy were able thereafter to sustain pressure without the development of otitis media. In at least some of the group not responding to radium therapy, the authors believe that other conditions than excess lymphoid tissue may have been the responsible factor. In one patient, for example, an old mastoiditis had caused considerable scarring, while another had a post diphtheritic paralysis of the right side of the throat and palate. As stated above the number of treatments varied, but it is clear from the recorded results that most ears sustained little or no damage after two applications.

Psychological therapy proved to be valueless and topical applications of a neosynephrine solution had but slight effect. Dental care in men with abnormalities of occlusion was remarkably effective.

The incidence of deafness in submarine personnel is considerably less than that reported in the Air Forces. The difference is explained in terms of the different barometric conditions which prevail between the two services. The usual flight consists of a decompression followed by return to normal pressure while submarine training consists of a compression followed by a return to normal pressure. In the case of submariners, then it will be seen that the negative pressure in the tympanum which produced vascular engorgement and rupture during the first or compression phase, changes to positive pressure during the second or decompression phase and the result is that the vascular system tends to shrink and a form of therapy is achieved. The reverse is true for the aviators in whom the second phase is one of compression the men reaching the ground at a time when symptoms are most pronounced. For these reasons a greater incidence and severity of pathological changes and loss of hearing acuity might be expected among aviators than among submariners.

Another account of this study appears in U S Naval M Bull 46 1529 October 1946.

STEPHEN N TAGER, M D

Radioactive Iodine in the Study of Thyroid Physiology VII. Use of Radioactive Iodine Therapy in Hyperthyroidism. Saul Hertz and Arthur Roberts J A M A 131 81-86 May 11 1946

Hertz and Roberts present their studies of the action of radioactive isotopes of iodine in 29 cases of hyperthyroidism. Two tables are included one listing their so-called failures in 9 cases and the other giving pertinent data in 20 cases listed as cures. In 5 patients subsequently operated upon (listed as failures) hypometabolism or true myxedema developed. By excretion studies external counter measurements over the thyroid gland planned operations in 2 cases and careful clinical studies data were obtained making it possible to construct a formula for treatment procedure. Doses ranging from 5 to 25 millicuries to uniodized patients were effective in the treatment of hyperthyroid-

ism in 80 per cent of cases The resultant dosage expressed in roentgens closely approximated the dosage of roentgen therapy in the authors' opinion The addition of ordinary iodine therapy after administration of radioactive iodine offered many advantages in clinical care of patients and safety of the procedure No mortalities or undesirable complications such as tetany or loss of phonation occurred There were no undesirable radiation effects tracheal or laryngeal irritations or anemia, in any of the cases D A KOCH, M D

(University of Michigan)

Treatment of Hyperthyroidism with Radioactive Iodine Earle M Chapman and Robley D Evans J A M A 131 86-91, May 11, 1946

A report of an additional 22 carefully selected cases of hyperthyroidism treated with radioactive iodine is presented by Chapman and Evans Their work supplements the previously reported investigations of Hertz, Roberts, and Evans In these cases, considerably larger doses were used and no other treatment was instituted Two tables and several B M R charts as well as case histories are presented The preparation of radioactive iodine and tissue effects are discussed By iodine retention curves the authors were able to predict dosages and found that a patient who swallowed 14 millicuries of radioactive iodine received a radiation dose equivalent to approximately 3,490 roentgens This radioactive iodine is carried in about one milligram or less of ordinary iodine and is concentrated largely in the thyroid gland Reactions simulating radiation sickness were observed in 6 cases Biopsy of the thyroid in 2 cases showed definite fibrosis following this treatment.

Cases of recurrence following surgery and patients sensitized to iodine and thiouracil responded well to this form of therapy Recoveries were observed in 14 patients after ingestion of a single dose Two doses were necessary in 3 patients and in 5 patients three doses

were given Only 2 patients had signs of residual hyperthyroidism after therapy Myxedema occurred in 4 cases

D A KOCH, M D
(University of Michigan)

DOSAGE

A Direct-Reading X-Ray Intensity Comparator Its Radiological and Physical Applications L A W Kemp Brit J Radiol 19 233-242, June 1946

The construction and calibration of a twin chamber intensity comparator is described This may be used to measure percentage depth doses, intensity distributions across or along a beam, half-value layers, and dosage rates SYDNEY J HAWLEY, M D

Roentgen Dose Distribution in the Thorax Experimental Study Olof Sandström Acta radiol 27 433-439, May 6, 1946 (In German)

The author has carried out experiments for the determination of intensity with Sievert's small condenser chamber at different depths in the lungs of newly slaughtered calves with thoracic walls of different thicknesses The experimental appliance is described and the results are set forth graphically, the curves showing the roentgen dose at different depths as percentage of the surface dose The results are compared with those obtained by Quimby and others in measuring the intensity in cadavers

Radiation Measurements on a Continuously Evacuated Roentgen Tube for 400 kV Sigvard Eklund and Sven Benner Acta radiol 27 264-268, May 6, 1946 (In English)

Measurements of dosage rates and half-value layers of the roentgen rays from a continuously evacuated roentgen tube are reported for voltages of 250-350 kv and for two different target designs

EFFECTS OF RADIATION

Osteoradionecrosis of the Mandible Edwin A Lawrence Am J Roentgenol 55 733-742, June 1946

The author believes that the pathogenesis of osteoradionecrosis is not clearly understood probably because investigative studies with heavy protracted fractionated irradiation have not yet been reported The three important factors in the production of the necrosis are heavy irradiation, trauma, and infection Its occurrence in the mandible is relatively frequent following heavy irradiation for oral carcinoma

The mandible receives its blood supply from a single nutrient artery the inferior dental, and from the periosteum It is formed of dense compact bone with a high calcium content Because of this, it receives an increased amount of soft, scattered radiation resulting in a high intrinsic dose which may exceed that of the adjacent soft tissues It has been stated that the periosteum is highly susceptible to irradiation and that the osteoblasts may be completely destroyed, thus explaining the lack of bone regeneration after sequestrectomy or subperiosteal bone resection The macroscopic integrity of the bone is usually maintained after exposure to heavy radiation until infection or trauma is added, following which gross disintegration of bone

occurs Apparently sound teeth in the field being irradiated may subsequently become carious, and their removal is likely to be followed by disintegration of the mandible Prophylactically all teeth should be removed prior to irradiation Minimally, the teeth in the direct beam should be removed and a period of at least ten days allowed before irradiation to permit healing in the tooth sockets Rigid post-irradiation oral hygiene is important to prevent deep mucous membrane ulceration which may eventually extend down to bone

Once osteoradionecrosis has occurred, the lesion should be handled with extreme conservatism and no attempt made to remove the sequestrum until it has become so loose that it can be lifted out with forceps During the long period of sequestration the involved area should be kept as clean as possible

Six cases illustrating the factors contributing to osteoradionecrosis, its treatment, and course are reported in detail H H WRIGHT, M D

Treatment of Roentgen Sickness with Oral Administration of Pyridoxine Hydrochloride (Vitamin B₆) Robert J Reeves South M J 39 405-407, May 1946

One hundred cases of roentgen sickness have been ob-

served by the author since March 1944. Forty five of these patients were being treated by roentgen rays for carcinoma of the cervix, rectum, or bladder, with an average of 8,000 to 10,000 r distributed over the pelvis. The usual field of irradiation measured 10 X 15 cm. Treatment was usually started with 150 r directed to each of two opposing ports, and this dosage was increased by 50 r daily until 300 r was being delivered to each port. Pyridoxine hydrochloride (vitamin B₆) was administered at the onset of the roentgen sickness and continued as long as nausea persisted, 50 mg was given orally in the morning about four hours before irradiation, another 25 mg at noon and 25 mg before the evening meal—a total daily dose of 100 mg. An occasional patient who did not respond to pyridoxine hydrochloride by mouth was benefited by intravenous injection. In 25 of the 45 cases in the above group the results were good, in 16 moderate, and in 4 poor.

Among 55 patients with nausea and vomiting following roentgen irradiation over the thorax and upper abdomen for postoperative carcinoma of the breast, lymphoblastoma, polycythemia, and Marie-Strümpell arthritis good results were obtained with pyridoxine hydrochloride in 52, moderate in 2, and poor in one.

A Clinical Syndrome Following Exposure to Atomic Bomb Explosions. Paul D Keller. *J A M A* 131:504-506, June 8 1946.

Studies were made on 21 patients with delayed illness following exposure to atomic bomb explosions in Japan in 1945. Cases receiving severe blast injuries or extensive external burns at the time of explosion were not included. The symptoms and findings are similar to those following excessive irradiation of the body by x-rays. Within distances of 2,000 yards from the center of explosion there appeared to be no significant difference in the possibility of developing the illness. That all patients save one were indoors at the time of explosion would make it appear that delayed effects are more likely to become manifest in those who are protected though incompletely provided they survive the initial effects.

There were five deaths, the average interval being twenty six days after the explosion. Patients were hospitalized after an average of one month following exposure. The delayed effects on the body are attributed to destruction or suppression of elements of the hemopoietic system (leukopenia, thrombocytopenia, increased bleeding time, hemorrhagic tendency with

anemia, weakness, and fever) and disturbance of liver function (albuminuria, tyrosinuria, hypoproteinemia, jaundice, and fever). An increased erythrocyte sedimentation rate was present in evidence of extensive tissue destruction.

L. A. POZNAK, M.D.
(University of Michigan)

Inactivation of Viruses by Radiations. D. E. Lea. *Brit J Radiol* 19:205-212, May 1946.

As viruses represent a position intermediate between inorganic and living tissue, their behavior under irradiation may give some light on its biological effects. The literature covering experiments on the inactivation of viruses by gamma, alpha, and x-rays is reviewed and the following conclusions are reached. Inactivation of a virus in dilute aqueous solution occurs indirectly, that is, as a secondary effect of the ionization. Larger doses are required for dry viruses or concentrated solutions indicating that the effect under these conditions is direct. There is evidence to show that a single ionization is sufficient to inactivate a virus particle. There is a correlation between the size of the virus particle and the dose. Larger doses are required for smaller particles.

SYDNEY J. HAWLEY, M.D.

Effect of Dose Rate Variations on Mitosis and Degeneration in Tissue Cultures of Avian Fibroblasts. I. Lasnitzki. *Brit J Radiol* 19:250-256, June 1946.

Tissue cultures from the choroids and sclerotics of chick embryos were exposed to x-rays in varying doses and intensities. The effect of the radiation was graded by mitotic and degenerating cell counts.

At a dose of 100 r, the initial inhibition of cell division was independent of the dose rate. The rates used were 9.3, 29.8 and 101 r/m. However, mitotic recovery was slowed down and the degenerating cell counts increased with decreasing dose rates.

With doses of 2,500 r, no dividing cells were found after irradiation at 101 r/m. Attempts at mitotic recovery occurred at 29 and 9.7 r/m. At this total dosage the degenerating cells increased with increasing dose rate. Two types of degenerating cells were seen: degeneration during the resting phase and during mitosis. Mitotic degenerations were seen only after the two lower dose rates were used. A dose of 2,500 r given in two equal halves at 101 r/m, separated by an interval of five hours, was more effective than when given in one continuous dose. In this case a greater number of degenerating cells during mitosis were observed.

SYDNEY J. HAWLEY, M.D.

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Venous Catheterization of the Heart

I Indications, Technics, and Errors¹

MERRILL C SOSMAN, M D

Boston, Mass

WERNER FORSSMAN (10, 11) was the first to pass a catheter into the heart of a living patient, doing it first on himself, with the help of a surgical colleague who made the incision over the median basilic vein in the antecubital space. Others (13, 14) subsequently used the same *technic for various purposes, and some of our radiological colleagues attempted visualization of the cardiac chambers and pulmonary arteries by this means* (2). The lumen of the catheter, however, was too small to permit rapid filling of the chambers with radiopaque material, and the introduction of the Robb-Steinberg technic of angiocardiology (15) has made catheterization of the heart unnecessary for that purpose. Courmand and Ranges (3, 4) and their associates have used the method more than any group in this country, largely in the study of cardiovascular dynamics, particularly in shock. Their report in 1941 stimulated others to use the venous catheter, and at the present time a considerable literature has accumulated on the subject.

Courmand (5), in 1945, reported 1,200 such examinations with no fatalities and no serious complications from the passage of the catheter. However, we know of one

death in another institution following the injection of diodrast through the catheter in a patient who had been injected with the same medium ten days before (16).

Fluoroscopy is an essential part of the procedure, yet we could find but one paper in the American radiological journals, that of Conte and Costa in *RADIOLOGY*, 1933 (2), mentioning the use of the right heart catheter for the purpose of better visualization of the pulmonary arteries. Most of the reports have been concerned with research problems and clinical investigations, but there are practical useful applications, particularly in the study of congenital heart disease, which we wish to emphasize.

INDICATIONS

Catheterization of the right heart is most useful in the study of hemodynamics, both in establishing the *normals* for physiological variations and the changes in the varied forms of heart failure, cardiopulmonary disease, and shock. It is valuable, also, in helping to establish the diagnosis more accurately in congenital heart disease. In addition, the method has been used in the study of cerebral, renal, and hepatic physiology in health and disease, by the collection of samples of blood from the

¹ From the Departments of Radiology, Peter Bent Brigham Hospital, and Harvard University Medical School, Boston, Mass. Presented before the Thirty second Annual Meeting of the Radiological Society of North America, Chicago Ill. Dec 1-6, 1946.

jugular (Fig 1, A), renal, or hepatic veins as desired

In our series, the first 100 such examinations were done for the following purposes

Congenital heart disease	39
Renal function studies	20
Normals	18
Other heart disease	15
Pulmonocardiac disease and others	8
TOTAL	100

The first such examination at the Peter Bent Brigham Hospital was done on Nov 8, 1944, and the one-hundredth on Nov 13, 1946. The original purpose of Dr Dexter, who with his team has carried out all of these examinations without a single mishap, was to study renal physiology, but it soon became apparent that the method could be more useful in the study of congenital heart disease, particularly in helping to select suitable patients for operation, and most of our recent cases have been of this type. The exact and accurate antemortem diagnosis of the individual type of congenital heart disease, which was formerly interesting but unimportant, has now, with the tremendous advances in curative cardiac surgery, become necessary and important. This method is one which can be of great help in such cases, as Dr Dexter will demonstrate in the following paper (6).

TECHNIC

The technic of performing venous catheterization of the heart has already been published (5). Slight modifications have been made from time to time by the different persons using the method. At present we use the single lumen catheter, size 9 French, made of woven silk, and radiopaque, with the orifice at the tip. It is 100 to 125 cm in length, flexible, and yet stiff enough so that it can be rotated by twisting the exposed end, without buckling. It should have a slight curve or bend near the tip to facilitate its passage into the different parts of the cardiovascular system, which is done by aiming it in different directions under fluoroscopic observation.

Under strict aseptic precautions, an incision is made through the skin over the median basilic vein in either the right or left antecubital space, using novocaine anesthesia. The catheter is then threaded into the vein, advanced under fluoroscopic guidance, and "aimed" at the desired area by pushing and twisting the proximal end. Success in getting the tip into the various chambers and into the pulmonary arteries depends, as in fishing, upon the patience and persistence of the operator.

Radioscopy is done on a horizontal table equipped with a spot-film device, and is made as brief as possible, compatible with the demands in the individual case. We use 80 kv, 4 to 5 ma of current, and as small a field (diaphragm) as possible. Observations are intermittent, not continuous, and the total exposure to any one part of the body surface is not allowed to exceed 10 minutes. A self-recording time-clock should be installed in the fluoroscopic circuit to prevent overexposure. For the same reason, all radioscopy in our department is controlled or supervised by one of the radiologists or residents in radiology. The spot films are made with 80 kv, 75 ma, and, in a patient of average thickness, an exposure of 0.2 second. This varies, of course, in younger and in more obese individuals from 0.1 to 0.4 second. In cases where there is some doubt as to the exact position of the tip of the catheter, oblique films are also taken.

The catheter is thus passed upward into the axillary vein, the superior vena cava, and into the right auricle. From there it may be passed downward into the inferior vena cava as the patient takes a deep inspiration, and into either right or left renal vein as desired, or into one of the hepatic veins. If the tip is turned medially in the right auricle by twisting the outer end, it may then be passed through the tricuspid valve into the right ventricle. The tip of the catheter moves with each cardiac pulsation—slightly in the auricle, but much more in amplitude of excursion when the right ventricle is entered. This helps to determine the intracardiac position of the

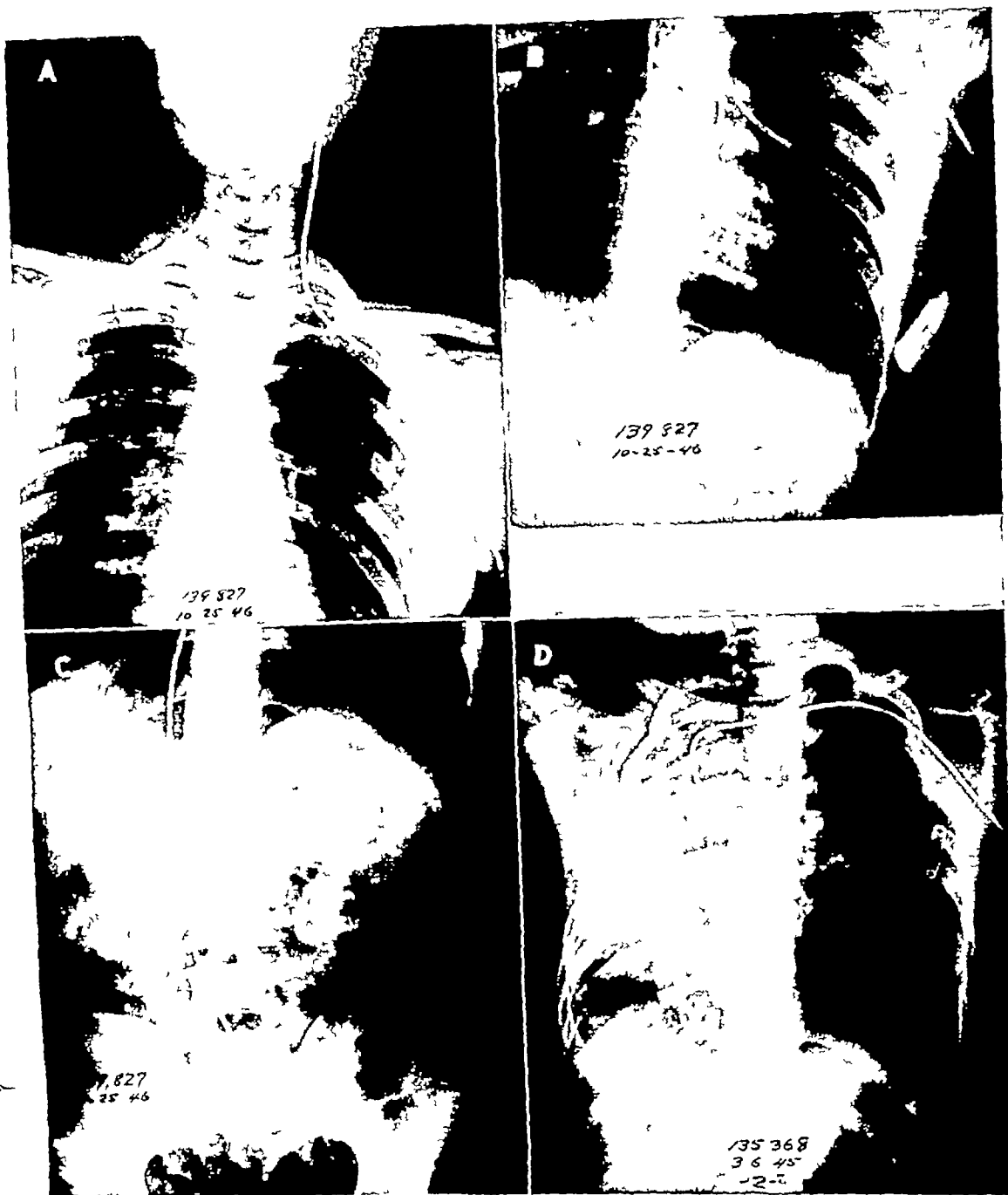


Fig 1 Normal controls, illustrating possible positions of intravenous catheter A In left jugular vein B Through the right side of the heart with tip in left pulmonary artery C Through right auricle into inferior vena cava, tip in left iliac vein D Through left axillary vein, superior vena cava, and right auricle, with tip in right ventricle The patient (J O S) shown in D had aplasia of the upper and middle lobes of the right lung, confirmed by lipiodol bronchograms, and dextrocardia The dense shadow around the tip of the catheter is diodrast in the right ventricle, injected through the catheter

catheter. The sudden elevation of pressure and the vigorous systolic pulsations, as shown by the manometer, when the right ventricle is entered, also help to locate the catheter. It may be coiled up in the right auricle and thus give a reasonably good idea of the size of this chamber (Fig 2).

From the right ventricle, the catheter may be introduced through the pulmonary valve into the pulmonary artery. At this point it may be guided into either the right or left pulmonary artery as desired, and may be passed well out into the smaller branches of the pulmonary artery until the tip occludes the branch in which it lies. In patients with congenital heart disease, two or three samples of blood are withdrawn through the catheter from the pulmonary artery or its branches, from the right ventricle, from the right auricle, and from the superior vena cava, and spot films are taken of the tip of the catheter in the various positions numbered to correspond to the numbered samples of blood. Before collecting the sample for analysis, 4 or 5 c c of blood are withdrawn and discarded, in order to avoid admixture and dilution with the saline perfusing the catheter. All samples are taken under oil to be analyzed for their oxygen content (5). The withdrawal of samples is facilitated by a Luer-Lok syringe with a tightly fitting adapter on the proximal end of the catheter. Clotting of blood in the catheter is prevented by a continuous perfusion of normal saline from a saline reservoir. Fifteen to sixty drops per minute is the usual rate of flow and is not enough to dilute the blood volume or to impair the accuracy of determinations from the samples taken. The hematocrit determinations and the oxygen capacity of the blood samples have been found to be unchanged during the procedure in a one-hour or two-hour period of observation.

The blood pressure in the various chambers was first recorded by a simple saline manometer, more recently by the Hamilton recording manometer (12). Blood flow to the periphery has been calculated by the

direct Fick principle of dividing the oxygen consumption by the arteriovenous oxygen difference between the femoral artery and the right ventricle, right auricle, or superior vena cava, depending on which is nearest the abnormal shunt. The pulmonary flow has been calculated by dividing the oxygen consumption by the arteriovenous oxygen difference between the femoral artery (or, in the case of certain shunts, an assumed value of 95 per cent oxygenation in the pulmonary vein) and the pulmonary artery. All patients have a basal metabolism test on the morning of the procedure, just preceding the catheterization, to determine their oxygen consumption. Arterial blood is withdrawn under oil by puncture of the femoral artery, for determination of arterial oxygen saturation.

The comfort of the patient is important for the success of the test. A synthetic rubber mattress is used for all patients and does not interfere with fluoroscopy or films. The arm is supported on a comfortable rigid armrest projecting at a right angle from the table, allowing easy access to the operative field, permitting freedom of movement by the operator, and avoiding contamination of the sterile operative field by the fluoroscopic screen. The patient's head is made comfortable on soft pillows, with the face turned away from the area of operation. This also avoids trauma to the patient's nose and chin when the fluoroscopic screen is moved into position. Commotions, noises, conversation, and interruptions are kept to a minimum. Sedatives may be used in nervous or apprehensive individuals, and in young children anesthesia may be required. So far this has not been necessary in our series of cases. Teamwork is essential. The minimum to secure adequate and accurate results would be three persons, the optimum number is five, namely, the catheter-passer, the instrument-handler (this includes the watching and regulating of the manometer, the saline reservoir, and the blood sample apparatus), a radiologist, a general handyman or diener, and a chemist to analyze the blood samples. The analyses

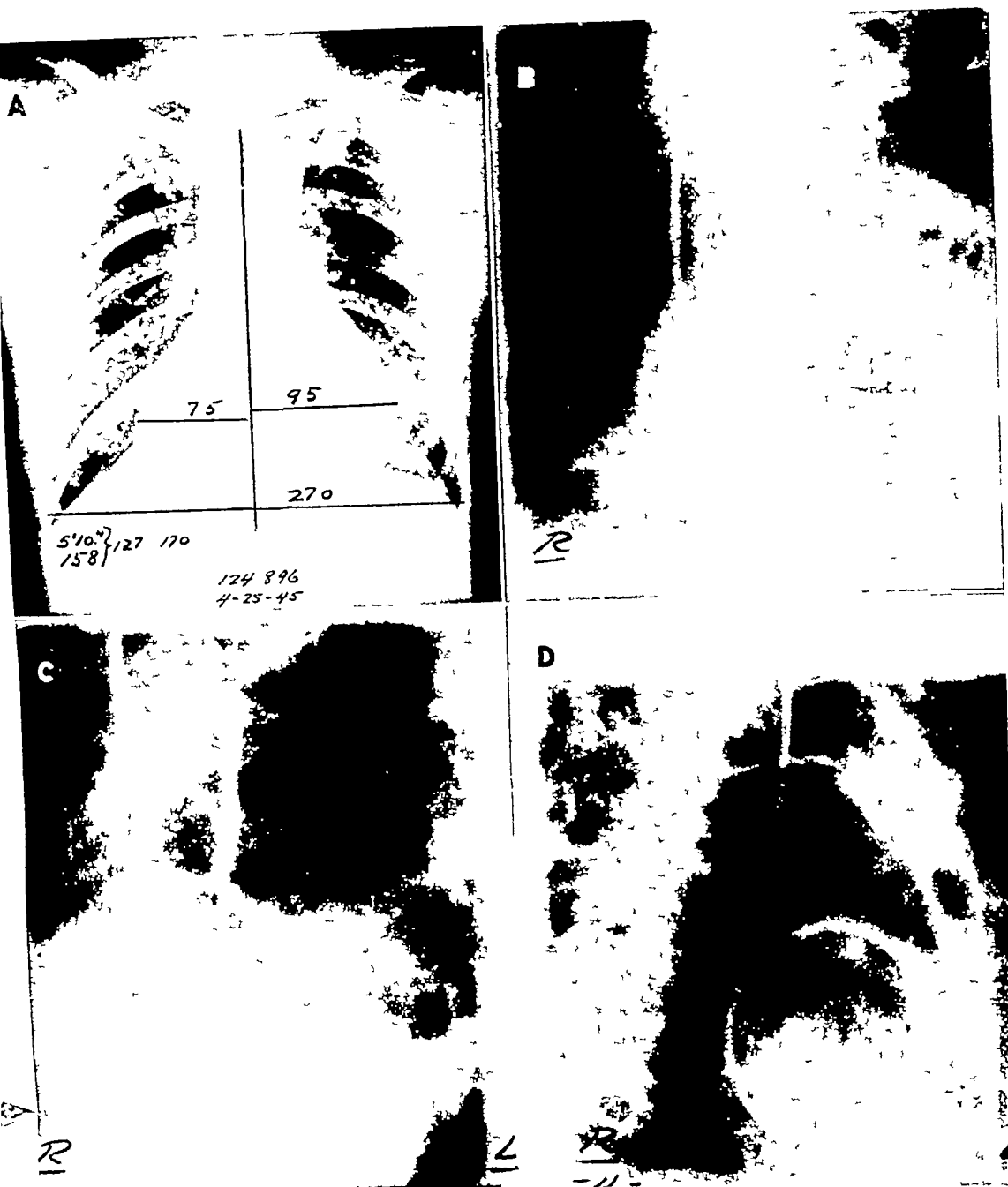


Fig 2 Course and position of the catheter in a patient with ventricular septal defect and large right auricle. A Seven foot film of the heart. B Spot film in postero-anterior position, showing catheter coiled in large right auricle with the tip in the right pulmonary artery C Same as B, in left anterior oblique position D Same as B, in right anterior oblique position The double contour of parts of the catheter is due to pulsations

Patient J B, aged 48, white male Known heart lesion since age of 3, cyanosis and clubbing all his life Loud grating systolic murmur best heard over fourth left interspace, widely transmitted Pulmonic second sound accentuated Polycythemia (r b c. 5 56 million, Hb 17 3 gm, hematocrit 53), EKG compatible with dextrocardia X ray studies revealed situs inversus abdominis, heart enlarged to right, right arched aorta. Findings on catheterization Right auricle oxygen content 15 5 volume per cent oxygen saturation 72%, pressure 8 mm Hg Right ventricle 19 3 volume per cent, 90 5%, 15 mm Hg Pulmonary artery 18 6 volume per cent, 77% 17 mm Hg Femoral artery 19 9 volume per cent, 92% Results indicate entrance of arterial blood into right ventricle which without pulmonic stenosis and with cyanosis and clubbing suggest Eisenmenger's complex Patient also had right arched aorta demonstrable by x ray, and double superior vena cava (see Fig 3, B)

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have been done in Dr Burwell's laboratory, the instruments have been prepared and cared for most adequately by Dr Florence Haynes, Dr Lewis Dexter has done the actual passing of the catheter, and the radioscopy has been done successively by my residents, Dr Roy Seibel and Dr Robert Sagerson

FAILURES AND ERRORS

Failure to secure adequate or reliable data from this test has been infrequent, only 13 examinations out of 100 were unsatisfactory. Spasm of the vein around the catheter in the arm may prevent passage to the desired spot but has not interfered with withdrawal of the catheter. Venospasm is more apt to occur if the patient is uncomfortable or in pain, and less apt to occur with good local anesthesia and with use of the rubber mattress. Novocaine should be used liberally around the skin incision. Two examinations were unsatisfactory owing to venospasm. Two others failed because of a poor catheter which did not have the proper curve at the tip and which could not be guided where desired. The other failures were due to kinking of the catheter at junction points in the venous system, to inexperience early in the series, to uncooperative patients, to failure of the manometer in one case, and to lack of adequate veins in two cases.

The errors inherent in the application of the Fick principle for calculating cardiac output by this method have been discussed by Warren, Stead, Weens, and Brannon (1, 17), particularly in relation to variations due to anxiety and to postural changes, and to the determination of cardiac output in man. They report results of observations on over 500 subjects and are concerned chiefly with the difficulty of obtaining well-mixed venous blood from the right auricle

and right ventricle. In their series, variations in oxygen content of blood from the right auricle and right ventricle were within reasonable agreement in 80 per cent of the determinations (not more than 0.4 volume-per cent), but exceeded this variation in the remaining 20 per cent. They conclude that if the right auricle or right ventricle is used as a source of venous blood for the determination of cardiac output, results will be accurate if treated statistically, but in individual cases errors of considerable magnitude may occur.

Cournand *et al*, however, found the percentage and degrees of error to be considerably less than reported by Stead *et al* and concluded that usually, but not always, well-mixed venous blood could be obtained in the right auricle close to the orifice of the tricuspid valve.

The findings of Stead and of Cournand and their co-workers have been confirmed in our hospital by Dexter *et al* (7, 8, 9). They have emphasized that blood in the right auricle and right ventricle occasionally varies considerably in oxygen content, probably due to the withdrawal of coronary venous blood (thebesian veins, coronary sinus). On the other hand, if several samples of blood are obtained from the pulmonary artery, there is rarely any significant variation in their oxygen content. These workers conclude that the Fick principle of calculating cardiac output is valid if the pulmonary artery is used as the source of mixed venous blood.

Cournand and associates (3) and Stead *et al* (17) found that the calculated cardiac output by the direct Fick method was 20 to 25 per cent higher than that with the methyl iodide and acetylene gas methods.

Some of the abnormal or unexpected situations in which the tip of the catheter was found are shown in the accompanying

Loud machinery murmur maximum in aortic area no thrill Hb 17.3 gm hematocrit 49 Circulation time, magnesium sulfate method, 8 seconds. X ray examination revealed cardiac enlargement chiefly left ventricle dilated and engorged hilar vessels and a right arched aorta. EKG showed right axis deviation. Findings on catheterization: Right auricle oxygen content 12.0 and 13.0 volume per cent, pressure \pm 4 mm Hg. Right ventricle (proximal) 14.0 volume per cent. Right ventricle (distal) 17.0 volume per cent pressure \pm 4 mm Hg. Aorta 18.7 volume per cent = 84% saturated pressure 110/70 mm Hg. Catheter did not enter pulmonary artery. Conclusions: Tetralogy of Fallot plus right arched aorta (Corvisart's syndrome) probably with patent ductus arteriosus. Calculated pulmonary blood flow through ductus arteriosus, assuming pulmonary atresia, 6.7 l/min peripheral blood flow 2.7 l/min.

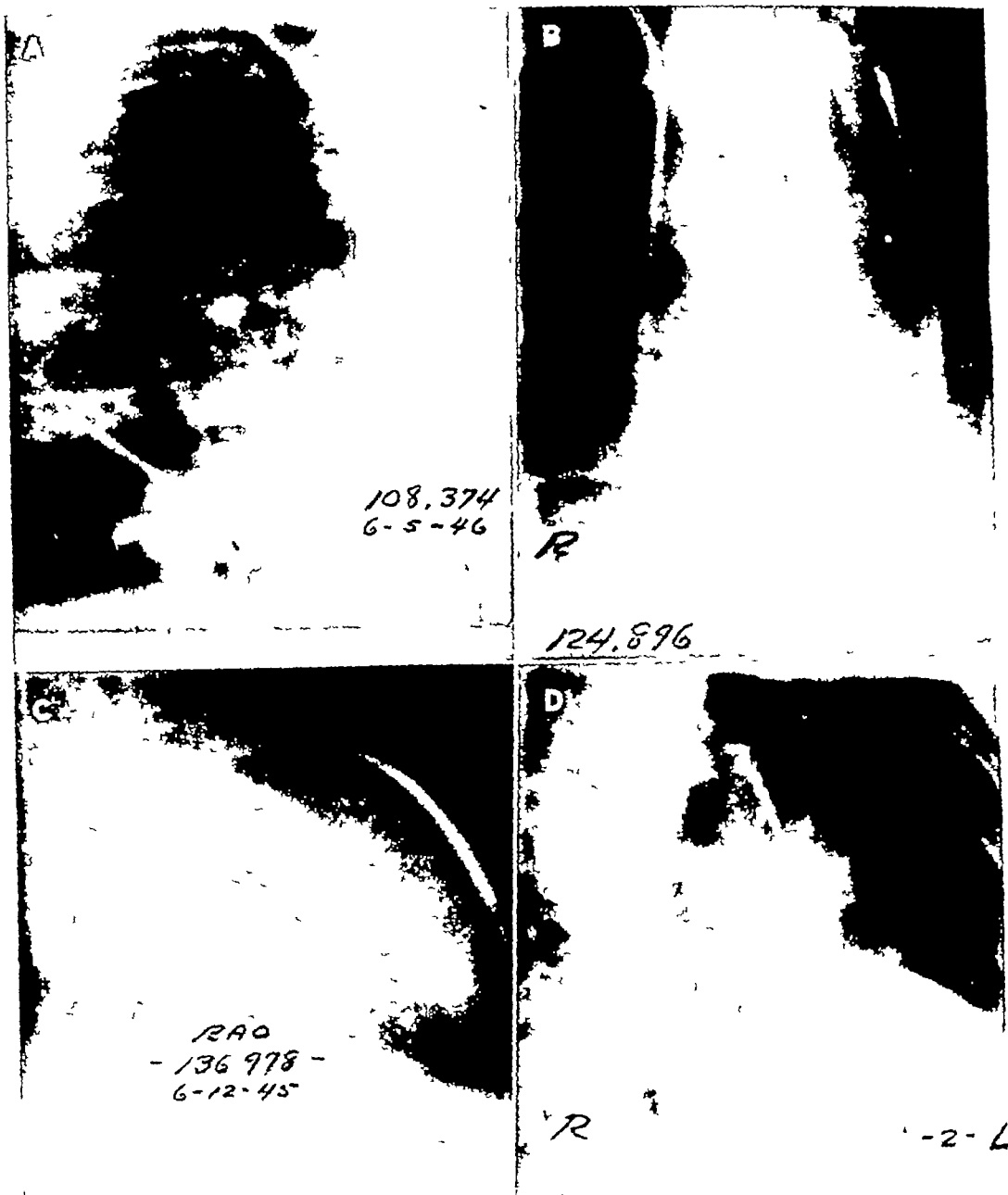


Fig 3 Several unusual positions of the catheter A Presumably in the azygos vein Oxygen content 10.7 volume per cent = 63% saturated same as superior vena cava. B Down right superior vena cava through right auricle and presumably up left superior vena cava. Oxygen content 14.2 volume per cent = 85% saturated, same as in right superior vena cava. C Catheter through right auricle into coronary venous sinus. The catheter maintained the same curve and position in oblique films and the distal portion lay just within the cardiac outline close to the pericardial margin. Oxygen content 7.4 volume per cent = 25% saturated, pressure 12 mm Hg. This very low oxygen saturation suggests blood from the coronary vein, in addition to the anatomical location of the catheter. D Catheter in right arch of aorta tip in descending aorta beside the spine. right anterior oblique position. Oxygen 8.1% saturated pressure through catheter 110/70 mm Hg.

D Patient H S aged 10 Known heart murmur since six weeks of age mild cyanosis since birth no clubbing

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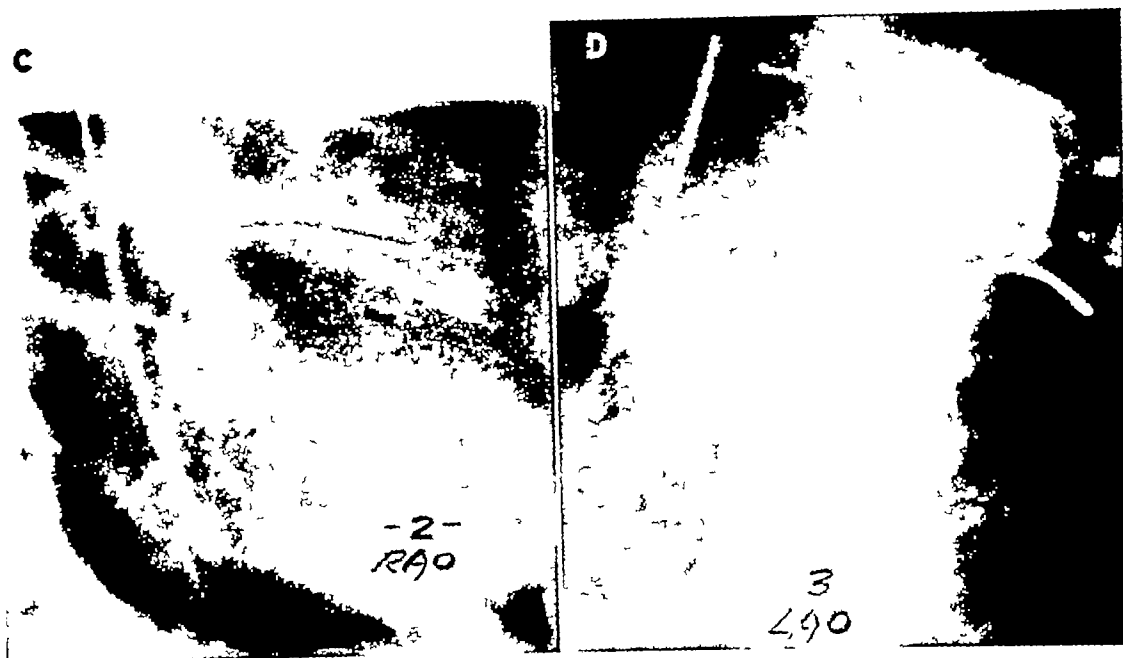


Fig 4 C and D Another case of auricular septal defect. C Catheter through auricular septal defect into left auricle and pulmonary vein, patient in right anterior oblique position D Same patient in left anterior oblique position

Patient E M, female aged 25 Cyanosis for five years, no clubbing Harsh diastolic murmur without thrill, maximal at fourth left intercostal space X ray study of heart revealed marked cardiac enlargement and huge pulmonary arteries EKG showed right axis deviation Catheter results were as follows

	Oxygen content, volume per cent	Oxygen saturation, per cent
Superior vena cava	13 0	60
Inferior vena cava	15 6	72
Right auricle	14 2	66
Left auricle	19 6	91
Pulmonary vein	21 2	97
Femoral artery	18 7	89

autopsies no trace of damage could be found in the lining endothelium of the superior vena cava, the right auricle, the right ventricle, the pulmonary arteries, or on the valves Many of the patients have local thrombosis of the vein at the point of incision, and a few have had mild inflammatory reactions around the area of skin incision All have subsided promptly on conservative treatment with no deleterious sequelae

The results of this procedure, the diagnostic dividends as it were, are discussed by Dr Dexter in the following paper

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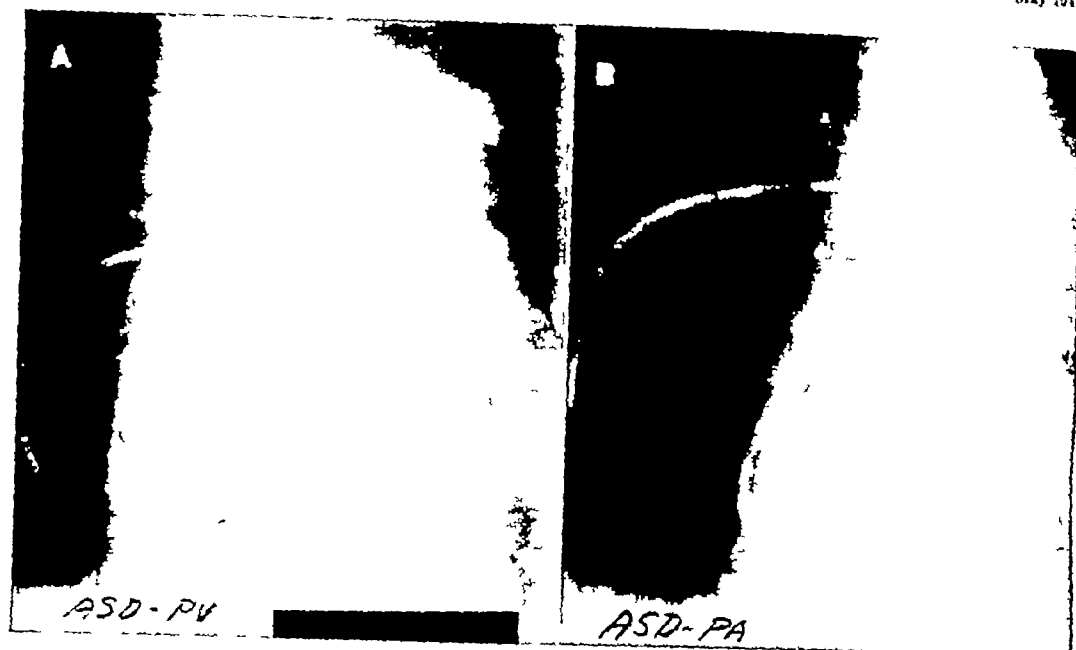


Fig 4 A and B Case of auricular septal defect with catheter passing through the defect into the left side of the heart A Catheter through auricular septal defect into left auricle and pulmonary vein B Catheter through right ventricle into pulmonary artery, same patient, same position

Patient K R, female aged 43 Blue baby slight cyanosis and clubbing all her life Grade 3 diastolic murmur maximal in fourth left intercostal space EKG showed right axis deviation Marked dilatation of pulmonary arteries demonstrable by x ray Oxygen content of blood in position A 18.8 volume per cent = 98% saturation, pressure 32/20 mm Hg, in position B 13.1 volume per cent = 68% saturation, pressure 85/32 mm Hg

illustrations, e g, in the coronary vein (2 cases)(Fig 3, C), in the azygos vein (Fig 3, A), in the aorta (2 cases of tetralogy of Fallot)(Fig 3, D), in a double superior vena cava (2 cases), and, after passing through an auricular septal defect, in the left auricle and pulmonary veins (2 cases) (Fig 4) The results of the pressure readings and the oxygen content of blood samples in patients with congenital heart disease are discussed by Dr Dexter in the following paper An early misleading finding was that of a higher-than-normal oxygen content in the pulmonary artery when the tip of the catheter was as far out as it would go in the artery It took but a little reasoning, deduction, and further investigation, however, to explain this finding on the ground that the catheter had occluded the lumen of the small artery and that therefore the blood withdrawn through the orifice in the tip of the catheter really came back from the pulmonary capillaries and veins, where the oxygen content would be that of the arterial blood

DANGERS AND SEQUELAE

When trying to pass the tip of the catheter through the tricuspid valve, ventricular extra systoles occur in about half of the cases This is the only subjective sensation in the great majority of patients A few have mentioned an accompanying sensation of tightness in the substernal area or neck, and one patient was made breathless when the tip of the catheter was still in the right auricle In only two instances were the subjective symptoms distressing enough to cause abandonment of the procedure

The dangers most commonly feared are damage to the endothelium of the large veins or of the heart, and the possibility of thrombus formation in or on the catheter So far no thrombi have been formed on the waxed catheter, and no clots in the catheter have formed if the saline perfusion is kept going at 15 drops per minute or more Several of this group of patients have succumbed to their disease or conditions not in any way related to the procedure, and in 10

Venous Catheterization of the Heart

II Results, Interpretations, and Value¹

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Boston, Mass

CONGENITAL heart lesions are notorious for their lack of characteristic signs and symptoms. The addition of venous catheterization, as developed by Courmand and Ranges (1), to the work-up of these cases presents an opportunity for the recognition of certain defects, for an estimation of the physiological magnitude of the shunts of blood, and for the study of the circulatory dynamics of these patients. Details of the procedure and methods of calculation of blood flows have been reported elsewhere (2, 3, 4, 5). Findings in representative types of congenital heart disease are herein described.²

AURICULAR SEPTAL DEFECT

In the presence of an auricular septal defect, blood usually flows from the left auricle to the right auricle. The venous catheter is helpful in the recognition of this defect by two methods, as described by Brannon, Weens, and Warren (6). The catheter may be introduced through the defect (4, 5) or arterial blood may be found in the right auricle (4). The following case report illustrates both methods in the same patient.

Case Report. K R, a 43-year old woman, had been a blue baby and had had cyanosis and clubbing of the fingers all her life. Since the age of 19 she had had exertional dyspnea which had not been progressive. Physical examination showed her to be undernourished but active, with slight cyanosis and clubbed fingers and toes. The heart was enlarged to the left. A grade 3 diastolic murmur was present in the fourth left intercostal space. The pulmonic second sound was accentuated. There were no physical signs of heart failure. An electrocardio-

TABLE I AURICULAR SEPTAL DEFECT (PATIENT K R)

Source of Blood	Oxygen Content, cc/l	Oxygen Saturation, %	Pressure, mm Hg
Superior vena cava	115	60	
Right auricle	132	69	0
	130	68	
	114	59	
	133	70	
	178	93	
Pulmonary vein	188	98	32/20
Right ventricle, upper	132	69	85/0
Pulmonary artery, branch	131	69	85/32
	133	70	
	131	69	
Femoral artery	165	86	104/70
A-P diameter of chest	19	cm	
Oxygen consumption	171	cc/min	
Body surface	1.54	sq m	
Oxygen gain by blood in lungs	57	cc/l	
Oxygen loss by blood in periphery	50	cc/l	
Pulmonary blood flow	3.0	l/min	
Peripheral blood flow	3.4	l/min	
Flow through defect			
Left to right	0.7	l/min	
Right to left	1.1	l/min	

gram showed right axis deviation. Roentgenography (Fig 1) and fluoroscopy of the heart revealed extreme dilatation and pulsation of the pulmonary artery and its branches. On venous catheterization (Fig 1), the catheter entered the right auricle and passed through a defect in the auricular septum into a pulmonary vein, where the oxygen saturation of the blood was 98 per cent (Table I). The femoral arterial oxygen saturation was only 86 per cent. The catheter was subsequently introduced into the right ventricle and pulmonary artery. The results are shown in Table I. A diagnosis of auricular septal defect seemed justified on the basis of finding arterial blood in the right auricle and of introducing the catheter through the defect.

¹ From the Medical Clinic, Peter Bent Brigham Hospital and the Department of Medicine, Harvard Medical School, Boston, Mass. Presented before the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec 1-6, 1946.

² The team for venous catheterization at the Peter Bent Brigham Hospital has consisted of Drs M C Sosman, R E Seibel, R P Sagerson, and M H Wittenborg of the Department of Radiology, Drs F W Haynes, H K Helms, and L Dexter, and Drs C S Burwell, E C Eppinger, and J M Evans of the Department of Medi-

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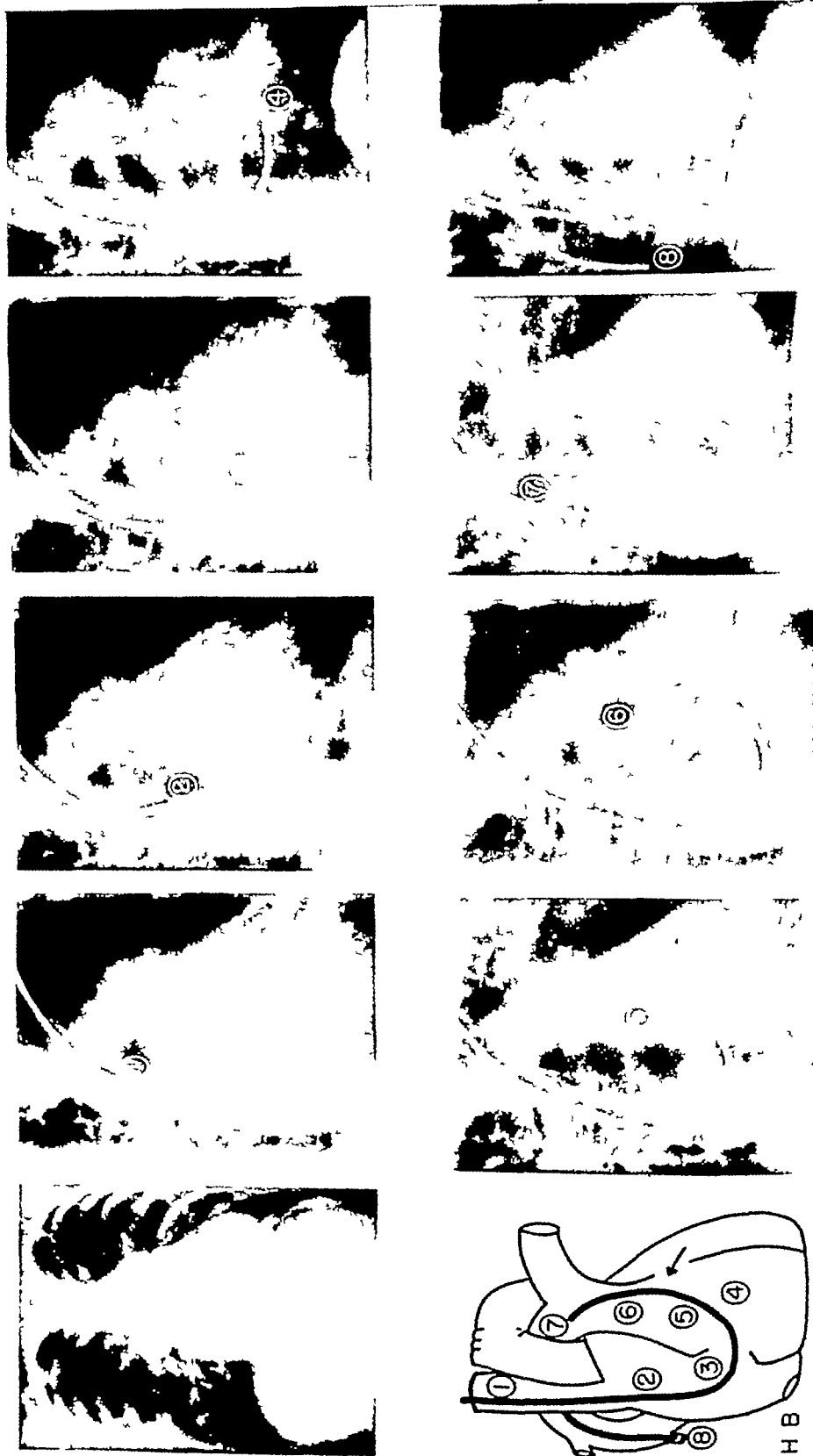


Fig 2 Ventricular septal defect The positions of the catheter are identifiable by the corresponding numbers in the schema

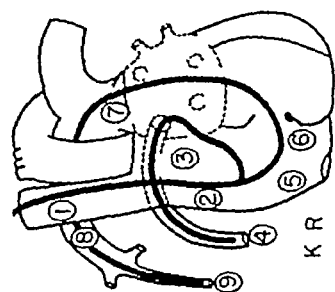


Fig. 1. Auricular septal defect. The positions of the catheter are identifiable by the corresponding numbers in the schema. In position 4 the catheter passed into the pulmonary vein through a defect in the intraauricular septum. Blood withdrawn from this position was arterial (see Table 1). In positions 8 and 9, the catheter passed through the right ventricle into the right branch of the pulmonary artery. Blood withdrawn at these sites was venous.

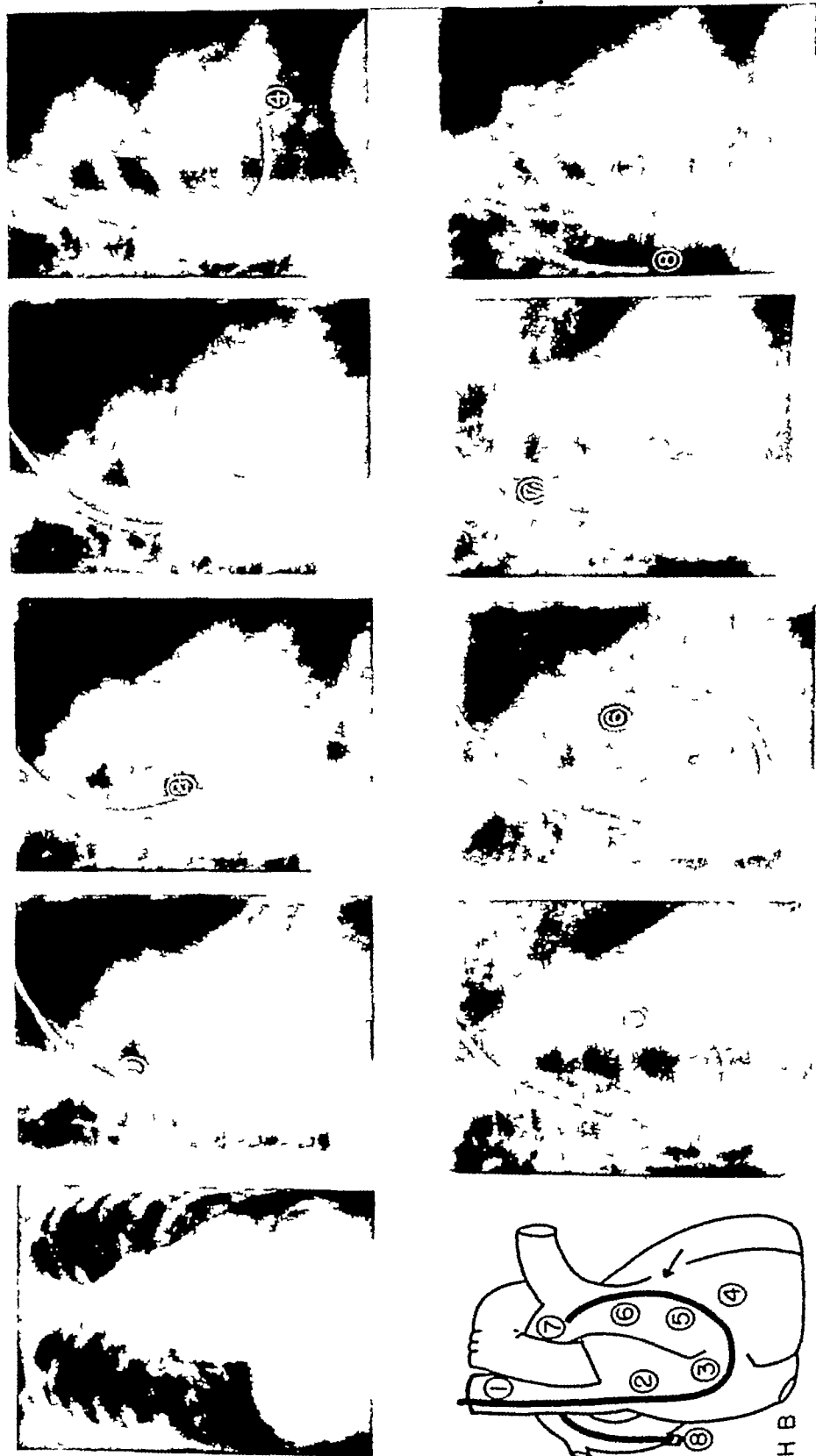


Fig 2 Ventricular septal defect The positions of the catheter are identifiable by the corresponding numbers in the schema

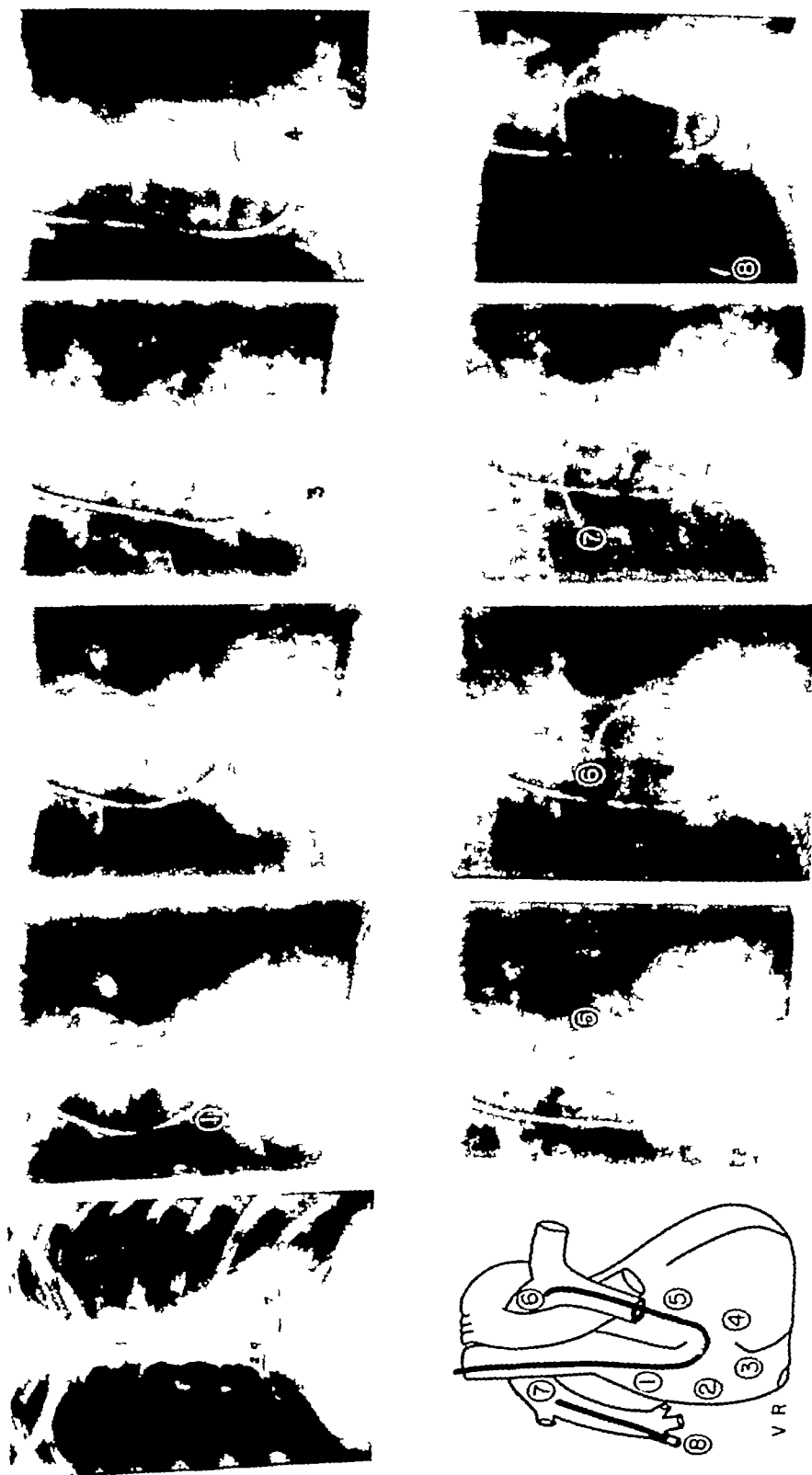


Fig 3 Tetrulogy of Fallot The positions of the catheter are identifiable by the corresponding numbers in the schema Note that the catheter passed through the stenotic pulmonary valve into the pulmonary artery

VENTRICULAR SEPTAL DEFECT

An uncomplicated defect in the interventricular septum results in a shunting of arterial blood from the left ventricle to the right ventricle. Its recognition by venous catheterization depends on finding a significantly higher content of blood in the right ventricle than in the right auricle. Two such cases have been recently described by Baldwin, Moore, and Noble (7).

Case Report H B, a 10 year-old boy, kindly referred by Dr Samuel A Levine, had had a known murmur since infancy. He had grown and developed normally and denied any limitation of activity. There was no history of cyanosis. Physical examination revealed a harsh grade-5 systolic murmur and thrill maximal at the third left intercostal space and a resounding pulmonic second sound. Roentgenography (Fig 2) and fluoroscopy of the heart revealed prominence in the region of the pulmonary artery and engorgement and pulsation of the hilar vessels. An electrocardiogram showed right axis deviation. Venous catheterization was performed, as shown in Fig 2, and the results are presented in Table II.

TABLE II VENTRICULAR SEPTAL DEFECT (PATIENT H B)

Source of Blood	Oxygen Content, cc/l	Pressure, mm Hg
Superior vena cava	133	
Right auricle		
Upper	135	15
At valve	126	
Right ventricle		
Lower	156	100/15
Mid	165	
Upper	165	
Pulmonary artery, branch	161	100/49
	161	
Femoral artery	183 (98%)	153/98

A-P diameter of chest	15 0 cm
Oxygen consumption	189 cc/min
Body surface	1 1 sq m
Oxygen uptake by blood in lungs	22 cc/l
Oxygen loss by blood in periphery	52 cc/l
Pulmonary blood flow	8 6 l/min
Peripheral blood flow	3 6 l/min
Flow through defect	5 0 l/min

It is seen that a considerable amount of arterial blood entered the right ventricle as indicated by the higher oxygen content of blood in the right ventricle than in the right auricle. Using the direct Fick principle for the calculation of blood flow (2), 5 0 liters of blood were calculated to flow through the defect per minute. Pressures in the pulmonary

artery and right ventricle were greatly in excess of normal.

TETRALOGY OF FALLOT

The tetralogy of Fallot consists of pulmonic stenosis, interventricular septal defect, over-riding or dextro-position of the aorta, and right ventricular hypertrophy. Due to the pulmonic stenosis, venous blood

TABLE III TETRALOGY OF FALLOT (PATIENT V R)

Source of Blood	Oxygen Content, cc/l	Pressure, mm Hg
Right auricle		
Upper	207	(9)
Lower	195	
Near valve	189	
Right ventricle		
Mid	210	140/9
Upper	198	
Pulmonary artery		
Stem	198	18/8
Branch	204	
Pulmonary capillaries"	276 (97%)	
Femoral artery	233 (82%)	

A-P diameter of chest	19 5 cm
Oxygen consumption	169 cc/min
Body surface	152 sq m
Oxygen uptake by blood in lungs	75 cc/l
Oxygen loss by blood in periphery	36 cc/l
Pulmonary artery blood flow	2 3 l/min
Peripheral blood flow	4 7 l/min
Flow through defect	
Right to left	2 6 l/min
Left to right	0 2 l/min

enters the pulmonary artery with difficulty and some is shunted through the septal defect and into the aorta. These patients are, therefore, cyanotic and suffer mainly from a deficient blood flow through the lungs. The venous catheter may follow one of two courses. It may pass through the stenosed pulmonary valve into the pulmonary artery, or it may pass through the interventricular septal defect and go directly into the over-riding aorta.

Case Report An example of the former instance was V R, a 29-year-old woman who had been a "blue baby" and had always had cyanosis, clubbing, and moderate restriction of activity. Physical examination showed normal development and a grade-3 pulmonic systolic murmur without thrill. In x-ray films of the heart (Fig 3) the apex appeared to be lifted up from the diaphragm, the hilar vessels

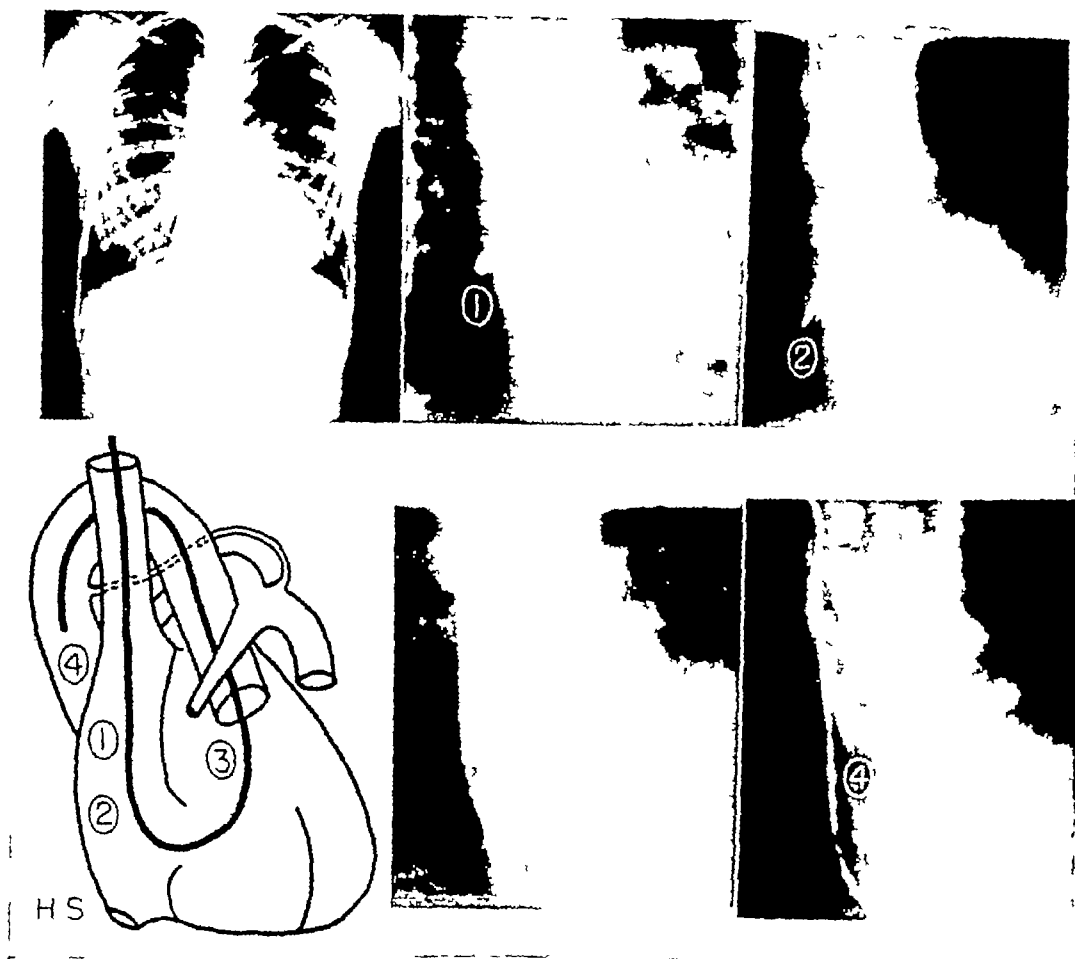


Fig 4 Tetralogy of Fallot right arching aorta, patent ductus arteriosus. The positions of the catheter are identifiable by the corresponding numbers in the schema. Note that the catheter passed through the right ventricle and into the right arching aorta.

were less prominent than normal, and the size of the pulmonary artery was within normal limits. The important findings on venous catheterization are shown in Fig 3 and Table III. The catheter passed into the pulmonary artery without difficulty. Pulmonary stenosis was indicated by the elevated pressure in the right ventricle and the low pressure in the pulmonary artery. An infundibular stenosis was suspected on finding a much lower pressure in the infundibular portion of the right ventricle than in the lower part of the right ventricle. This pressure difference in the two parts of the right ventricle was checked several times. Blood withdrawn from the pulmonary capillary and venous bed, as described elsewhere (3, 8), had an oxygen saturation of 96 per cent, and a simultaneous sample withdrawn from the femoral artery was only 82 per cent saturated. In the absence of roentgenologically demonstrable pulmonary disease, this finding was interpreted as indicating the existence of a right-to-left shunt of blood. This shunt was assumed to be

present through a defect in the interventricular septum because of the associated pulmonic stenosis. A diagnosis of tetralogy of Fallot seemed justified.

Case Report This case illustrates the passage of the catheter from the right ventricle into the aorta. H S, a 10-year-old boy, kindly referred to us by Dr Samuel A Levine had been observed to have a heart murmur in infancy. He had never been as active as his playmates and had always had a cyanotic tinge to his nails and lips. His heart was enlarged (Fig 4), and a typical machinery murmur of patent ductus arteriosus was present in the aortic rather than in the pulmonary region. The venous catheter passed through the right ventricle and into the aorta (Fig 4). From the course of the catheter, it is apparent that the patient had a right arching aorta and either a ventricular septal defect or an overriding aorta, or both. Pulmonary stenosis was assumed on finding a right ventricular systolic pressure identical with that of the aorta (Table IV). This assumption has been confirmed in another case.

TABLE IV TETRALOGY OF FALLOT AND PATENT DUCTUS ARTERIOSUS (PATIENT H S)

Source of Blood	Oxygen Content, cc/l	Pressure mm Hg
Aorta	187 (84%)	110/70
Right auricle Mid Upper	130 120	4
Right ventricle Near pulmonary valve Near tricuspid valve	173 140	110/4
A-P diameter of chest	17 5 cm	
Oxygen consumption	166 cc/min	
Body surface area	1 22 sq m	
Pulmonary arteriovenous oxygen difference (assuming patent ductus arteriosus as only source and 95% oxygen saturation of pulmonary venous blood)	25 cc/l	
Peripheral arteriovenous oxygen difference	62 cc/l	
Pulmonary blood flow (through patent ductus arteriosus assuming pulmonary atresia)	6 7 l/min	
Peripheral blood flow	2 7 l/min	

by autopsy Since the catheter could not be introduced into the pulmonary artery, the existence of a patent ductus arteriosus had to be assumed because of the quality of the murmur Its location on the right side was probably determined by the arching of the aorta to the right

PATENT DUCTUS ARTERIOSUS

Patent ductus arteriosus is a vascular anastomosis between the aorta and pulmonary artery which during fetal life serves to by-pass the lungs Its persistence after birth is deleterious, owing to the ease with which bacterial vegetations become implanted and also to the circulatory strain thrown on the left ventricle Since the flow of blood after birth is from the aorta, where the pressure is high, to the pulmonary artery, where it is low, there is no cyanosis and the lesion is detectable on venous catheterization by finding arterial blood in the pulmonary artery or, in other words, blood with a higher oxygen content in the pulmonary artery than in the right ventricle

Case Report S I, a 7-year old girl, had had a normal birth and development and at the age of 5 was found to have a heart murmur She had never experienced any symptoms referable to the heart Physical examination revealed no cyanosis or clubbing The blood pressure was 10S/20 mm Hg The

TABLE V PATENT DUCTUS ARTERIOSUS PREOPERATIVE (PATIENT S I)

Source of Blood	Oxygen Content, cc/l	Pressure, mm Hg
Superior vena cava	98	
Right auricle Upper Mid	100 104	18
Right ventricle Lower Upper	103 114	48/18
Pulmonary artery	137	48/33
Pulmonary "capillaries"*	156 (97%)	
A-P diameter of chest	14 5 cm	
Oxygen consumption	167 cc/min	
Body surface area	0 85 sq m	
Oxygen uptake by blood in lungs	19 cc/l	
Oxygen loss by blood in periphery	54 cc/l	
Pulmonary blood flow	8 8 l/min	
Peripheral blood flow	3 1 l/min	
Flow through shunt	5 7 l/min	

* This value is the same as that in a systemic artery when no right to left shunt exists (7, 8)

heart was overactive and enlarged to the left A typical "machinery" murmur, accompanied by a systolic thrill, was present in the third left intercostal space X-ray study of the heart (Fig 5) showed it to be enlarged to right and left, with marked engorgement of the hilar vessels Venous catheterization was performed as shown in Fig 5, and the results are shown in Table V It is seen that the oxygen content of blood in the pulmonary artery had a significantly higher oxygen content than

TABLE VI PATENT DUCTUS ARTERIOSUS POSTOPERATIVE (PATIENT S I)

Source of Blood	Oxygen Content, cc/l	Pressure mm H
Right auricle Upper At valve	134 134	3
Right ventricle Lower Mid Upper	136 133 135	32/3
Pulmonary artery Stem Branch	137 136	32/10
Femoral artery	175 (97%)	
A-P diameter of chest	14 5 cm	
Oxygen consumption	150 cc/min	
Body surface area	0 85 sq m	
Oxygen uptake by blood in lungs	40 cc/l	
Oxygen loss by blood in periphery	40 cc/l	
Pulmonary blood flow	3 8 l/min	
Peripheral blood flow	3 8 l/min	
Flow through shunt	None	

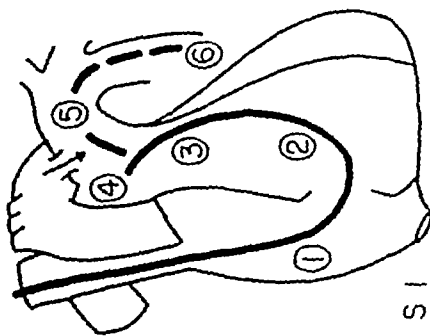
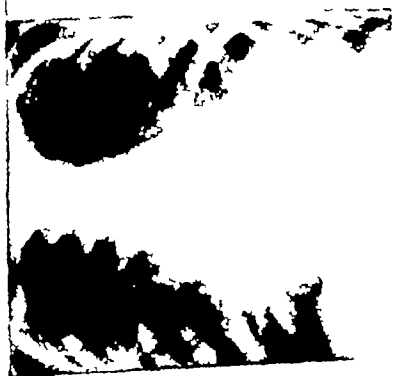


Fig 5 Patent ductus arteriosus, before operation The positions of the catheter are identifiable by the corresponding numbers in the schem

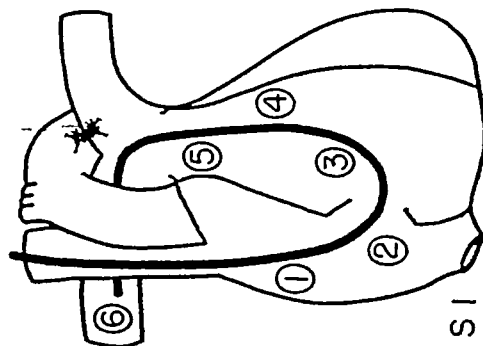
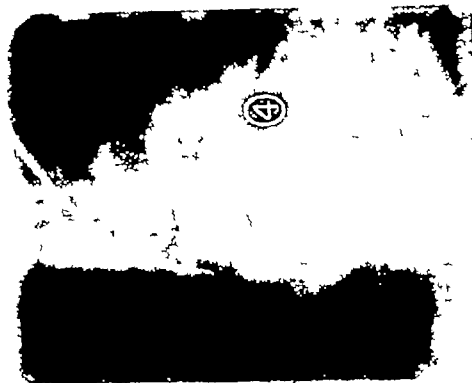
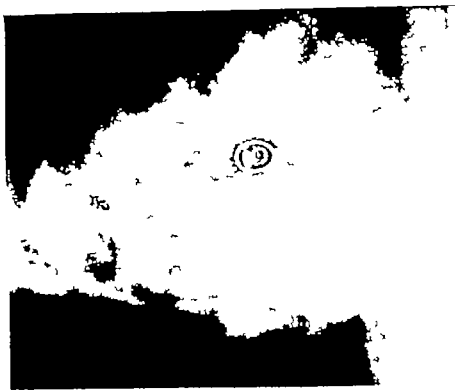


Fig 6 Patent ductus arteriosus, after operation The positions of the catheter are identifiable by the corresponding numbers in the schema

that in the right ventricle, denoting the entrance of arterial blood into the pulmonary artery. Dr Robert E. Gross explored this patient a few days later and divided a patent ductus arteriosus. Seventeen days later, venous catheterization was repeated (Fig 6). The oxygen content of bloods obtained from the various chambers were within normal limits (Table VI). Pressures, which were high preoperatively in the pulmonary artery, right ventricle, and right auricle, had returned to normal.

SUMMARY AND CONCLUSIONS

To obtain interpretable results in congenital heart disease, venous catheterization must be performed by a well trained team of at least three persons working smoothly and efficiently, and should be used in conjunction with the usual procedures of history, physical examination, electrocardiography, fluoroscopy and, if available, the Robb-Steinberg technic (9) of visualization of the cardiac chambers with diodrast. Venous catheterization is essentially a physiological procedure, and certain of its limitations have been pointed out in this paper. Now that cure or improvement of certain congenital cardiac defects is possible by surgery, venous catheterization promises to be an important aid in preoperative diagnosis.

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DISCUSSION

Wendell G. Scott, M.D. (St. Louis, Mo.) We have just heard the first major contribution in the diagnosis of congenital heart disease that has been brought before us in several decades. Here again is an example of the effective application of anatomic and physiologic methods to the radiographic study of heart disease.

As Dr. Sosman pointed out, catheterization of the right auricle has been an accepted technic for fifteen to seventeen years, but it remained for Dr. Sosman, Dr. Dexter, and others to develop this into a diagnostic procedure of practical clinical value. Their method brings us three things:

First, we have a probe that you can use to sound the different chambers of the heart in search for abnormal congenital foramina. This can be done under fluoroscopic guidance. Certainly it requires a skilled hand, the best of fluoroscopic assistance, but it has been amply demonstrated that it can be done—that it localizes an anatomic defect within the heart that before could not be demonstrated by any objective means.

Second, this procedure provides a method for measuring pressures within the different chambers of the heart and in the pulmonary arteries. This information can be applied to practical clinical diagnoses.

Third, this method permits us to remove samples of blood from the various chambers of the heart and determine whether or not the blood is venous or arterial and if it is arterial, whether it is in the correct chamber.

I was also impressed by the fact that this method has been developed in a center for the study of congenital heart disease and was stimulated largely by the desire of the surgeons to obtain a more accurate diagnosis in congenital heart disease, to determine where the defect was and whether or not it was operable. I do not know the number of people with congenital heart disease in the United States but

there must be many. What percentage of these people we can help we do not know, but certainly many have been already rehabilitated.

From personal experience, I have very little to offer. In 1934, with Dr. Warren Cole, we fed a catheter in the right auricle in an effort to introduce opaque solutions into the cardiac chambers. None of our patients complained of any subjective symptoms. At that time we did not realize the possibilities of using the catheter as a probe to seek out an abnormal foramen, which is the contribution here.

Technically, I would like to ask Dr. Sosman if the catheter is introduced into the basilic vein through a trocar or fed directly through the vein. Second, I am interested in the translucent mattress described for the radiographic table.

Also, I would like to emphasize here, as both Dr. Sosman and Dr. Dexter have pointed out, that this work was done by a team—a radiologist, an internist, a surgeon, a chemist, and a physiologist, all working together to perfect a better method for the diagnosis of congenital heart disease.

I do not feel that their percentage (13 per cent) of failures is significant when we realize that they were developing a new technic, and I presume many of their patients were children, who are difficult to handle.

In closing, I want to say that I am much impressed by the thoroughness with which the work has been done and by the clinical applications that have been brought out. I am wondering if it is advisable for us, as radiologists, to make these examinations unless we have groups of men in our hospitals who can do something with the information after it is given to them. In other words, if the surgeons are not trained to do the operative procedures on the heart, perhaps it would be best to defer such examinations to a team that is functioning and that is associated with cardiac surgeons.

Leo Rigler, M.D. (Minneapolis, Minn.) Any one who has had to examine cases of cyanotic heart disease to determine whether or not the patient is a candidate for the Blalock operation will, I am sure, fully appreciate the value of the procedure that Dr. Sosman and Dr. Dexter have outlined.

The crux of that problem—which has certainly plagued us, at least, to the greatest degree—is whether or not the patient really has a pulmonic stenosis, that is, whether one is dealing with an adequate circulation of the lungs, whether there is a real tetralogy of Fallot or an Eisenmenger defect or, as in one of the cases Dr. Sosman showed, there is a tetralogy with a pre-existing patent ductus, which of course would make the operation unnecessary, or whether, as in some cases, there is a tetralogy with a collateral arterialization of the lungs to such a degree that the operation may be unnecessary.

That is a problem that we have had almost no success in solving by ordinary means. I wonder if

Dr. Dexter would say a word about the utility of this procedure for its solution.

Merrill C. Sosman, M.D. (closing) I would like to thank Dr. Scott for his generous discussion. I will try to answer some of his questions and will leave the others to Dr. Dexter.

Originally the catheter was passed through a hollow needle, but the catheter would occasionally catch on the point of the needle and, after the first few times, that practice was abandoned. The catheter is now passed directly into the vein itself.

The mattress is ordinary sponge rubber, 4 cm thick, and does not seriously interfere with fluoroscopy or spot filming.

It is important, I think, to emphasize that the fluoroscopy should be under the control—or at least the guidance and supervision—of someone acquainted with the dangers of fluoroscopy. That has not been pointed out as far as I know in any of the papers on this subject so far. We try to limit fluoroscopy to as small a field as possible and try to make it intermittent, so that there is no excessive exposure of any one part. As you can readily see, the field is moved around from place to place as the tip of the catheter is advanced or withdrawn.

Spot films, ordinarily six to eight in an individual case, add very little to the danger of overexposure. It would be wise to have an automatic recording time-clock in the circuit so that the operator would know exactly how much exposure has been given, calculating in advance what the maximum safe exposure can be.

The 13 per cent failures mentioned by Dr. Scott were in the first hundred cases and I am sure the percentage dropped considerably in the second half of those hundred cases as we acquired facility.

I think Dr. Scott also emphasized a very important thing—that methods as a rule are developed to meet a demand. There has been a demand for estimation or recording of pulmonary pressures before this, but not a particularly vigorous demand, mostly from the physiologists. Here is a critical situation when the surgeons say, "Shall we operate or shall we not?"

Cardiac surgery has reached such a degree of development that some method of more accurate preoperative determination of the exact status was imperative, and this I think has met that demand to a large extent, though not yet entirely. It is complementary to the other methods, such as the Robb-Steinberg technic, the routine methods of physical examination, and fluoroscopy.

Lewis Dexter, M.D. (closing) It is necessary to evaluate patients in the usual way, on the basis of history, physical examination, electrocardiography, and fluoroscopy. Unless the operator has a pretty fair idea, ahead of time, as to what defects he is looking for, he may very well overlook on routine venous catheterization one or more of the abnormalities present.

The Robb-Steinberg technic, of course, should not be considered as an alternative to venous catheterization, but as a complementary study. It gives information of a different sort. Venous catheterization is essentially a physiological technic. The Robb-Steinberg method is essentially an anatomical method, and the two go hand in hand.

I agree with Dr. Scott that this technic will never become an office routine. It will be confined pretty much to those centers where there is an interest in congenital heart disease and where cardiac surgery is being practised. There are many hospitals that are setting up the technic with this point in mind, *i.e.*, as a preoperative diagnostic procedure.

Dr. Rigler has asked if Eisenmenger's complex (where there is no pulmonary stenosis) can be differentiated from the tetralogy of Fallot (where pulmonary stenosis is present). In the former, the Blalock operation is not indicated, in many of the latter, it is. The presence or absence of pulmonary stenosis can be recognized accurately by venous catheterization and, I think, this method is valuable in differentiating these two groups. I do not be-

lieve, however, that there is clear cut differentiation between Eisenmenger's complex on the one hand and the tetralogy of Fallot on the other. There appears to be a whole spectrum between the two extremes. We have studied a number of patients, mostly adults, who have appeared to be in perfect circulatory balance with a moderate degree of pulmonary stenosis and with a reduced pulmonary blood flow, but not enough, in our opinion, to justify the Blalock operation. Bing, in Baltimore, has studied many tetralogy patients and has used respiratory methods as well as venous catheterization for the determination of pulmonary blood flow. Using these technics, he has been able to obtain information with regard to the amount of collateral circulation through the lungs. Venous catheterization alone gives a fairly accurate indication of the amount of blood flowing through the pulmonary artery but gives no information concerning the collateral circulation. I believe it is fair to say that information derived from a successful catheterization is sufficient to make an accurate diagnosis of the tetralogy of Fallot.



Cholangiography and Biliary Regurgitation¹

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CHOLANGIOGRAPHY, the roentgen study of the biliary tract by means of the direct introduction of a contrast medium, may be accomplished in a number of ways and with a number of contrast substances. The material may be injected directly into the gallbladder or the common duct—immediate cholangiography—at the time of a surgical exploration of the biliary tract. Roentgenograms are then made on the operating table (Fig 1). More commonly the injection is made postoperatively through a drainage tube previously inserted into the gallbladder or the common duct—delayed cholangiography.

Recently some efforts have been made to inject a radiopaque substance into the gallbladder before operation. This can be accomplished by either of two procedures. A catheter can be placed in the gallbladder through a simple abdominal incision. Cholangiography is then done and the situation of the biliary tract determined (Fig 2). The information obtained will govern the exact type of surgery to be undertaken. Another method is that suggested by Horan (1) and Marcel Royer (2). Under the guidance of a peritoneoscope introduced into the peritoneal cavity, a needle is thrust into the gallbladder and the biliary tract is thus injected with the contrast medium. Roentgenograms may then be obtained and the presence or absence of calculi, strictures, tumors or other abnormalities may be determined.

In the first attempts at cholangiography, Carnot and Blamoutier (3) used a barium suspension as a contrast medium but the medium was unsatisfactory, so the effort was unsuccessful. The first satisfactory result was accomplished by Lanari and Squirru (4), using lipiodol. A clear de-



Fig 1 Immediate cholangiogram. At operation the bile ducts were injected through a cannula in the cystic duct. Even though the surgical specimen of the gallbladder contained stones, the surgeon was assured by the series of cholangiograms that none was present in the biliary ducts. Hence it was not necessary to explore the common duct nor to drain it postoperatively.

lineation of the major biliary ducts was obtained. This medium is still used by many radiologists, notably in South America. In this clinic, iodized oil as a contrast medium for cholangiography was abandoned many years ago because of its viscosity, its tendency to form globules, and the uneven distribution which resulted (Fig 3). Following this we used thorotrast (thorium dioxide sol), finding it a most satisfactory substance because of its great opacity to x-rays and its ready miscibility with aqueous solutions. An unfortunate experience led us to discontinue its use. A patient, in whom a tube had been placed in the common duct during the course of a cholecystectomy, was given an injection of thorotrast through this opening. The

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Fig 2 Injection of biliary system through cholecystostomy tube. The tube is seen extending into the gallbladder. Both the intrahepatic and extrahepatic portions of the biliary tree are filled. The entire duodenum is also visualized. Preoperative injection of the gallbladder under peritoneoscopic control would produce the same type of filling.

tube, however, had been diverted from the duct and the inner end was lying in the peritoneal cavity. The contrast medium was therefore introduced into the peritoneal space. The result was a violent reaction, high fever, and evidences of peritoneal irritation. Recovery eventually occurred, but the thorium dioxide remained in the sinusoids of the peritoneum and in the lymph nodes for many years. Since the material may possibly be carcinogenic when introduced directly into subcutaneous or subserous tissues, we have felt it unwise to use it when there was even a remote possibility that it would not be readily excreted.

Since 1939, we have used organic iodine compounds, most commonly diodrast, for cholangiography. Such substances can be used in variable concentration, are readily



Fig 3 Lipiodol cholangiogram. There is poor filling of the ducts. The medium tends to form droplets of various sizes because it is not miscible with bile. The smaller biliary radicles are not filled because lipiodol is too viscous.

miscible with bile giving a uniform opacity, are relatively non-irritant, and are quickly absorbed and readily excreted through the kidneys if introduced outside the biliary tract.

About six years ago an interesting observation was made by one of us in several cases, an observation concerning which we have found no mention in the literature. It was noted on some of the roentgenograms of the biliary tract made fifteen to thirty minutes after the injection of diodrast that not only was the biliary duct system visible but also one or both of the kidney pelves could be seen (Figs 4-6). It was apparent at once that this phenomenon of excretion of the dye through the kidneys following cholangiography occurred only in cases with partial or complete obstruction of the common duct. The terminal hepatic radicles appeared well distended, and little or no dye was found in the intestine.

Recently the films of 126 patients on whom cholangiography was done since 1939 have been reviewed to determine the frequency of the appearance of the contrast medium in the kidneys. There were 460 individual cholangiographic studies in this

series, since in many cases several examinations were made. A total of 8 cases were found in which the kidney pelves were clearly delineated. In all of these there was partial or complete obstruction of the distal portion of the common bile duct due to stone. No case was found without such obstruction.

Kidney excretion of diodrast used in cholangiography probably occurs more frequently than the above data indicate. The kidney shadows are commonly hidden by gas, fecal material, or contrast medium in the bowel overlying the kidneys. Likewise small quantities of the dye might be overlooked. Consequently an optimum



Fig 4 Regurgitation of contrast medium. Case 1. Film made on June 10 1941, fifteen minutes after injection. There is obstruction of the distal common duct, allowing no contrast medium to pass into the bowel. The duct system is dilated and well filled. Contrast medium is seen in the calices and pelvis of the right kidney and in the calices of the left kidney (arrows).

In several of our cases on which multiple cholangiographic studies were made, the kidney pelves were filled with dye during one study but not during another. In both instances the ducts appeared to be well distended. The kidney shadows could be well visualized and were not hidden by gas or other confusing shadows. The lack of visualization in some studies probably indicates that sufficient pressure was not applied during the injection of the common duct to cause regurgitation from the biliary radicles into the blood stream.

set of circumstances must prevail if this phenomenon is to be observed.

Three possible explanations may be considered for the findings described above. The dye might conceivably be absorbed from the intestine and then excreted. The presence of obstruction and the absence of dye shadows in the bowel would contravene this explanation. A second possibility is that the dye is absorbed into the blood stream from the mucous membrane of the biliary tract and then excreted through the kidneys. If simple absorption

of the diodrast by the bile-duct mucosa plays an important part in this phenomenon, then the dye should gain access to the blood stream and the kidneys in every cholangiogram with good filling of the duct system. As already indicated, kidney filling can be demonstrated in only a very small percentage of cases with good duct filling. Moreover, in several of our cases demonstrating this regurgitation phenomenon, the dye could be seen in the kidneys as early as fifteen minutes after the injection and in one case as early as five minutes. It does not seem likely, if simple absorption were the important factor, that the iodine compound would reach the circulation and the kidneys so rapidly. Shafiroff and Bierman (5) have published experimental data which are of interest in this regard. After ligating the cystic duct in cats and preserving the gallbladder lymphatics and vessels, they injected various radiopaque substances into the lumen of the gallbladder. Crystalloidal substances such as diodrast, skiodan, sodium iodide, and uroselectan were found to be absorbed in six hours and were demonstrated in the kidneys several hours later. Although this represents absorption by the gallbladder rather than by the biliary ducts, it would seem reasonable to believe that there would be even less absorption by the ducts than by the viscus. In all of our clinical cases the gallbladder had been eliminated from the system. Therefore, the fact that we have demonstrated dye in the kidneys in a matter of minutes following the injection would speak against simple absorption as an important factor in producing the kidney shadows in our cases.

The most likely possibility lies in the phenomenon of biliary regurgitation. An understanding of the pressures involved within the biliary duct system is necessary before the reasons for various types of cholangiographic duct filling become apparent. Various investigators have made measurements of the average normal pressures found within the human biliary duct system. According to Doubilet (6) the

average maximum secretory pressure of the liver is 350 mm water. The normal resistance of the sphincter of Oddi is 150 mm water, and the maximum contracting force of the gallbladder is about 250 mm water. This would indicate that under normal conditions the sphincter of Oddi could be forced open by the gallbladder contraction. Under normal physiological conditions, however, the sphincter relaxes simultaneously with the contraction of the gallbladder. In addition, bile cannot ordinarily be forced up the hepatic ducts against the higher secretory pressure of the liver by the contracting gallbladder. Normally the gallbladder maintains about 100 mm of pressure within the duct system. Under conditions of normal sphincteric resistance, when the contrast substance is injected into the common duct, it usually empties through the ampulla into the duodenum without good filling of the hepatic ducts and especially the smaller biliary radicles. Under such normal conditions it is difficult to study the proximal portion of the common duct and the hepatic ducts because of the poor filling. Consequently, morphine should be given the patient before the injection of the dye if one is to obtain good filling of the proximal portions of the duct system in the absence of increased resistance in the distal portion of the common duct. In one of Doubilet's cases, the normal sphincteric resistance was 150 mm water. Following the administration of morphine, it required a pressure of 370 mm water to open the ampulla. Similarly in cases with obstruction in the distal common duct, such as stricture, spasm, or stone, it is much easier to obtain a good filling of the proximal ducts because this obstruction of the distal duct makes it possible to apply pressure equal to or above the hepatic secretory pressure. In some cases there is good filling of the hepatic radicles in spite of apparently rapid emptying into the duodenum. This indicates that, previous to the making of the film, there was some increased resistance at the ampulla which allowed dye to be forced in a proxi-

mal direction followed by relaxation of the spasm, permitting dye to pass into the duodenum. This might occur with injection of cold material causing spasm at the ampulla followed by relaxation as the material became warm.

During the past 150 years there have been much discussion, theorizing, and experi-

erally accepted by most recent investigators.

This entire concept has been well summarized by Rich (7) as follows: Each hepatic sinusoid is lined by a continuous endothelial membrane which separates the sinusoid from the lymph space surrounding each hepatic lobule. Normally the endo-



Fig 5 Regurgitation of contrast medium. Case 2. Film made on Aug 29, 1944, fifteen minutes after injection. A stone can be seen obstructing the distal common duct. Little or no dye is seen in the bowel. The calices of the right kidney and the calices, pelvis, and upper ureter of the left kidney are well delineated (arrows).

mentation concerning the route of regurgitation of materials from the biliary system into the general circulation. Some have held that regurgitation takes place directly into the hepatic sinusoids and hepatic veins, while others believe that regurgitation occurs chiefly through the hepatic lymphatics and the thoracic duct. A third group believes that either route may be followed, depending upon the stage of obstruction and the amount of pressure applied. The latter concept has been gen-

erally accepted. When the liver cells become atrophic and shrink away, it is easy to demonstrate this lining. Rich believes that the fact that, in early obstructive jaundice, bile pigment appears in the lymph earlier than in the blood stream is itself evidence that the lymph space is separated from the blood by a complete lining. Bile under beginning pressure, then, apparently passes first into the adjacent lymph space by diffusion, with only slight diffusion through the

endothelium into the hepatic sinusoids. In later stages of obstruction, with higher pressures being applied to the duct system, many of the canaliculi actually rupture, allowing the contents to spill freely into both the lymph spaces and hepatic sinusoids directly.

From the above considerations, it appeared most likely that we were dealing with a process of regurgitation of the contrast medium into the blood stream as a result of the pressure applied. Further studies, as yet unpublished, have since been made on animals under controlled conditions, with diodrast, thorotrast, radioactive phosphorus and bacteria, all of which establish this explanation unequivocally.

The significance of this observation is twofold. It tends to establish firmly the correctness of the theory that regurgitation of substances in the biliary tract into the blood stream may occur if sufficient pressure is exerted. In addition, it affords a new explanation for the reactions which occasionally attend cholangiography.

It is not uncommon to observe mild or even severe febrile reactions after injection of the biliary tract. It has been noted that such reactions follow only in cases with biliary tract infections. The demonstration of regurgitation of contrast medium during cholangiography suggests a possible explanation for such reactions. If contrast medium can be regurgitated into the blood stream, it seems reasonable to believe that bacteria present in the biliary system could be forced into the blood stream as well. Recent experimental work carried out on dogs in our laboratory indicates that this is true. Details of this work will be reported later.

Some investigators have suggested that simple dilatation of the biliary radicles is the cause of reactions. In none of our 8 cases with regurgitation into the blood and kidneys was there any report of reaction either mild or severe. The biliary system in all 8 cases was obviously distended. However, in no case was there any evidence of biliary tract infection.

The absence of bacteria in the bile ducts would decrease the chance of any bacteria being forced into the blood stream. This probably explains the absence of reactions in the presence of obvious regurgitation.

Others, such as Mallet-Guy (8), have attributed severe reactions following cholangiography to regurgitation into the pancreatic duct. Bergh (9) of our clinic, however, recently studied a series of cholangiograms and found that the pancreatic duct was filled in about one-third of these. Reactions following cholangiography occur only in a small fraction of this percentage, which would seem to indicate that this duct filling is probably not the explanation for reactions.

Since the possibility of forcing material from the biliary tract directly into the blood stream exists, it seems obvious that great care should be exercised in doing cholangiography. Pressures should be kept at as low a level as possible consistent with reasonably good filling of the intrahepatic ducts. In all probability, fluoroscopic control should be utilized to permit the use of a minimal degree of pressure. Furthermore, as much asepsis as possible should be observed.

Three cases will be reported in detail to illustrate the observations recorded above.

CASE 1 (29 year-old female) On entering the hospital the patient complained of attacks of right upper quadrant pain, fatty food distress, and jaundice during the past three years. Laboratory tests indicated common duct obstruction. At laparotomy, April 30, 1941 a stone was found in the common duct near the ampulla. Two stones were present in the gallbladder. Following cholecystectomy and probing of the common duct a small catheter was sutured into the cystic duct.

Subsequent to surgery, the tube could not be clamped without drainage around it. Cholangiograms made May 14 and June 10, 1941, revealed a stone in the distal common duct with dilatation of the hepatic and common ducts. On the latter examination, the phenomenon of contrast medium in both kidney pelvis was observed on the films made fifteen and forty five minutes after the common duct injection. Figure 4 shows the fifteen minute film.

On June 13, 1941 re-exploration revealed a stone which was removed from the distal common duct. On July 17, 1941 a repeat cholangiogram revealed no residual common duct stones.

There was no evidence of reactions following any of these common duct injections. The patient apparently was free from cholangitis.

CASE 2 (48-year-old female) The patient's chief complaints on entering the hospital were jaundice and right upper quadrant pain of three months' duration. An x-ray film of the right upper quadrant on May 25, 1944, revealed numerous calcified gallstones and a single calcified stone in either the cystic or the common bile duct. Laboratory tests indicated obstruction of the common bile duct. At

was removed. An immediate cholangiogram during surgery showed no evidence of common duct stone. A cholangiogram on Sept. 14, 1944, indicated the common duct to be normal.

There were no reactions following any of the common duct injections and no evidence of cholangitis.

CASE 3 (44-year-old female) The patient's chief complaints on entering the hospital were right upper quadrant pain, chills, fever, jaundice, night sweats, nausea and vomiting, dark urine, and acholic stools for several months. Laboratory tests indicated



Fig. 6. Regurgitation of contrast medium. Case 3. Film made on June 14, 1945, thirty minutes after injection into the common duct. The kidney structures are very well delineated bilaterally (arrows) indicating that a large volume of contrast medium must have gained access to the blood stream. The picture compares with that produced during the usual excretory pyelogram.

surgery, on June 15, 1944, seven stones were removed from the common duct and five from the gallbladder. A T-tube was placed in the common duct and left for drainage. Following surgery, the patient was not able to clamp the drainage tube without distress. Cholangiograms on Aug. 18 and Aug. 29, 1944, revealed stones in the common duct. On the latter examination, in addition, contrast medium could be visualized in both kidneys on the film made fifteen minutes after the injection of the common duct. Figure 5 is a reproduction of this film.

Repeat laparotomy on Aug. 31, 1944, revealed in the distal common duct a single large stone, which

obstruction of the common bile duct. A cholecystogram on Jan. 9, 1945, was interpreted as representing a non-functioning gallbladder. On Jan. 25, 1945, laparotomy was carried out. Multiple stones were found in the gallbladder and two were present in the cystic duct. A T-tube was left in position in the common bile duct.

On Jan. 25, 1945, a cholangiogram immediately following surgery indicated that a stone was still present in the distal common duct. The bile ducts were dilated considerably. On Feb. 5, 1945, a cholangiogram revealed the same findings. In addition, the phenomenon of filling of both kidney pelvises was evident on the films made twenty-five minutes

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Fig 6 Regurgitation of contrast medium minutes after injection into the common duct bilaterally (arrows) indicating that a large volume of contrast medium must have gained access to the blood stream. The picture compares with that produced during the usual excretory pyelogram.

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obstruction of the common bile duct. A cholecystogram on Jan. 9, 1945, was interpreted as representing a non-functioning gallbladder. On Jan. 25, 1945, laparotomy was carried out. Multiple stones were found in the gallbladder and two were present in the cystic duct. A T-tube was left in position in the common bile duct.

On Jan. 25, 1945, a cholangiogram immediately following surgery indicated that a stone was still present in the distal common duct. The bile ducts were dilated considerably. On Feb. 5, 1945, a cholangiogram revealed the same findings. In addition, the phenomenon of filling of both kidney pelvises was evident on the films made twenty-five minutes

endothelium into the hepatic sinusoids. In later stages of obstruction, with higher pressures being applied to the duct system, many of the canaliculi actually rupture, allowing the contents to spill freely into both the lymph spaces and hepatic sinusoids directly.

From the above considerations, it appeared most likely that we were dealing with a process of regurgitation of the contrast medium into the blood stream as a result of the pressure applied. Further studies, as yet unpublished, have since been made on animals under controlled conditions, with diodrast, thorotrast, radioactive phosphorus and bacteria, all of which establish this explanation unequivocally.

The significance of this observation is twofold. It tends to establish firmly the correctness of the theory that regurgitation of substances in the biliary tract into the blood stream may occur if sufficient pressure is exerted. In addition, it affords a new explanation for the reactions which occasionally attend cholangiography.

It is not uncommon to observe mild or even severe febrile reactions after injection of the biliary tract. It has been noted that such reactions follow only in cases with biliary tract infections. The demonstration of regurgitation of contrast medium during cholangiography suggests a possible explanation for such reactions. If contrast medium can be regurgitated into the blood stream, it seems reasonable to believe that bacteria present in the biliary system could be forced into the blood stream as well. Recent experimental work carried out on dogs in our laboratory indicates that this is true. Details of this work will be reported later.

Some investigators have suggested that simple dilatation of the biliary radicles is the cause of reactions. In none of our 8 cases with regurgitation into the blood and kidneys was there any report of reaction either mild or severe. The biliary system in all 8 cases was obviously distended. However, in no case was there any evidence of biliary tract infection.

The absence of bacteria in the bile ducts would decrease the chance of any bacteria being forced into the blood stream. This probably explains the absence of reactions in the presence of obvious regurgitation.

Others, such as Mallet-Guy (8), have attributed severe reactions following cholangiography to regurgitation into the pancreatic duct. Bergh (9) of our clinic, however, recently studied a series of cholangiograms and found that the pancreatic duct was filled in about one-third of these. Reactions following cholangiography occur only in a small fraction of this percentage, which would seem to indicate that this duct filling is probably not the explanation for reactions.

Since the possibility of forcing material from the biliary tract directly into the blood stream exists, it seems obvious that great care should be exercised in doing cholangiography. Pressures should be kept at as low a level as possible consistent with reasonably good filling of the intrahepatic ducts. In all probability, fluoroscopic control should be utilized to permit the use of a minimal degree of pressure. Furthermore, as much asepsis as possible should be observed.

Three cases will be reported in detail to illustrate the observations recorded above.

CASE 1 (29 year old female). On entering the hospital, the patient complained of attacks of right upper quadrant pain, fatty food distress, and jaundice during the past three years. Laboratory tests indicated common duct obstruction. At laparotomy, April 30, 1941, a stone was found in the common duct near the ampulla. Two stones were present in the gallbladder. Following cholecystectomy and probing of the common duct, a small catheter was sutured into the cystic duct.

Subsequent to surgery, the tube could not be clamped without drainage around it. Cholangiograms made May 14 and June 10, 1941, revealed a stone in the distal common duct with dilatation of the hepatic and common ducts. On the latter examination, the phenomenon of contrast medium in both kidney pelves was observed on the films made fifteen and forty-five minutes after the common duct injection. Figure 4 shows the fifteen minute film.

On June 13, 1941, re-exploration revealed a stone which was removed from the distal common duct. On July 17, 1941, a repeat cholangiogram revealed no residual common duct stones.

tube Very recently a patient—a surgeon brother-in-law of mine—wandered afar and had a common duct stone removed His surgeon wished to know the caliber of his common duct I did a cholangiogram, using lipiodol He objected, due to the pressure necessary and asked that I instill 5 c.c. of neo-iopax by gravity I did, and I did not precede it by a test for sensitivity The patient suffered a tremendous reaction, with a fearful outpouring of bile, shock, and prostration

I wonder, then, if cholangiograms are to be made routinely by the use of diodrast or neo-iopax, whether we shall also employ some test of sensitization to iodine, and, if so, what would be considered a reliable test I should like to ask Dr Mixer to comment on this point

Merrill C Sosman, M.D. (Boston, Mass.) I think some difficulties would be or could be avoided if fluoroscopy were used routinely during the injection I should like to ask Dr Mixer if that is part of his procedure It certainly is of ours

I would call attention to the very first film shown where dye had been injected—I presume in the operating room—which was said to show a perfectly normal duct so that the surgeons knew there was no stone present This is an entirely erroneous conclusion, for any number of small stones could be obscured by a common bile duct which was as well filled as that one was

If the injection is done under fluoroscopic control, you can see the duct being filled and, as in the case of a small foreign body or small tumor of the esophagus, the opaque dye will first go around it and then cover it up Serial spot films may be taken as the common duct is being filled, and at the same time you will avoid any increased pressure which may cause this regurgitation of dye into the biliary tract

This next is an entirely different subject but a parallel circumstance occurs, which I have run across twice I would like to call your attention to it, and I'm sure that, if it is called to your attention, many of you will see it, also This occurrence Dr Mixer has reported happens only when there is obstruction of the common duct, as I understand it If in the use of priodax to outline the gallbladder there is obstruction to the renal outflow on the right side—in other words, a hydronephrosis of the right kidney—you may get a similar filling of the right renal pelvis from the priodax test and that shadow—if the renal pelvis is nice and round and its calices are not too definite—may simulate exactly a normal gallbladder Thus we have as you see, the exact parallel set of circum-

stances, except that the things are reversed I have seen this happen twice, and I am sure some of you may have seen it, also

I should like to congratulate Dr Rigler and Dr Mixer on their very excellent paper

Leo G. Rigler, M.D. (*closing*) On the question that Dr Allen raised, I may say that we have never seen what we would consider a diodrast reaction or an iodine reaction after cholangiography This is over a period of about six years, and I am not aware of any such reactions reported in the literature We have seen reactions, as Dr Mixer said, but these were febrile, not the usual type of allergic reaction that one gets after intravenous introduction As a matter of fact, we do not use testing even in intravenous urography, so we obviously would not in this situation and I really don't know what we would do about it We have no confidence in pre intravenous sensitization tests

What Dr Sosman says is, of course, quite correct I think Dr Mixer passed rather rapidly over that one film merely as an illustration of what an immediate cholangiogram would look like We usually have several films—one with the duct partially filled and one with it fully filled The delineation of the duct was a little better, because it was fully filled, but judgment is made on more than one film

There is no doubt, however, that Dr Sosman's statement to the effect that fluoroscopic control might avoid a certain amount of difficulty is correct Nevertheless, one must bear in mind that if you want to fill the biliary ducts, a certain amount of pressure above the secretory pressure of the liver has to be exercised Of course, if one only wishes to fill the extra-hepatic portion of the common duct, it might be possible to accomplish this without much pressure. But in many instances, especially in patients in whom there is already an obstruction of the distal end of the common duct, some pressure must be applied, and even under fluoroscopic control I have no doubt that one would produce the amount of pressure which would lead to this regurgitation phenomenon That is what happened in the dogs that Dr Mixer worked on, and the amount of pressure needed to produce the excretion was really very small, so that I doubt whether fluoroscopic control would eliminate that in every case

I might add to Dr Sosman's parallel—that is, the injection of diodrast during retrograde pyelography into one kidney and getting it seen in the other kidney by way of a pyelovenous reflux, is a somewhat similar situation

after the common duct injection. The dye could not be visualized in the kidneys on the fifteen-minute film in this case, however. Cholangiograms on Feb. 15 and March 7, 1945, again indicated the common duct stone and dilated ducts, but no contrast medium was demonstrable in either of the kidneys, which should have been easily visualized if it were present. A cholangiogram made on June 14, 1945, demonstrated two stones in the distal common duct and dilatation of the ducts. On the thirty-minute film dye could again be seen in both kidney pelves. This is demonstrated in Figure 6. On June 26, 1945, two stones were removed from the common bile duct. Immediate cholangiography during surgery indicated that all of the stones had been removed.

There were no reactions following any of these common duct injections, neither was there any indication of cholangitis, which probably explains the absence of reactions.

SUMMARY AND CONCLUSIONS

The observation of the excretion of organic iodine compounds through the kidneys after injection into the biliary tract is recorded.

Such excretion appears to occur uncommonly, being observed in 8 cases out of a series of 460 cholangiograms.

It is invariably associated with obstruction of the common duct.

The evidence indicates that the contrast medium finds its way into the blood by regurgitation through the liver. The phenomenon of biliary regurgitation is thus further established.

It is probable that the reactions following cholangiography are due to a transient bacteremia rather than to distention of the bile ducts. In doing cholangiography, therefore, care must be exercised to keep the injection pressure low enough to avoid the danger of regurgitating bacteria or other foreign material into the blood.

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DISCUSSION

Walter Palmer, M.D. (Chicago, Ill.) is an internist primarily interested in the digestive tract. I must confess to a great weakness for the roentgenologic method. I do not need to apologize for that weakness to this particular audience. X-ray is the easiest, most available, most convenient, and most practical method available for the study of the digestive tract, particularly in man.

The paper just presented shows the way in which the experimental and clinical approaches to a problem may be combined. It also illustrates the way in which a prepared mind may make a very significant observation in the course of a routine study. Dr. Rigler and Dr. Mixer were astute enough to notice, in this rather large group of cholangiograms, that under certain circumstances the renal pelvis was visualized. It seems to me they made the correct deduction from that and set to work to verify it experimentally.

I see no escape from the conclusion they have drawn with regard to the significance of their observation and the so-called regurgitation phenomenon in jaundice. They have shown definitely and conclusively that the dye can be absorbed from the biliary tract and rapidly excreted into the kidney. The speed with which this takes place seems to indicate regurgitation from the biliary canaliculae directly into the blood stream through the blood sinusoids in order for the dye to be excreted by the kidney in the time in which it is excreted. Of course it may be, also, that the dye escapes from the biliary canaliculae into the lymphatics, but lymphatic escape alone would apparently not explain the rapid excretion of such large amounts of dye into the kidney pelvis.

I should like to congratulate the authors of this paper on their splendid presentation.

Lewis Allen, M.D. (Kansas City, Kans.) I should like to take a moment to raise the question of the use of diodrast and iopax in cholangiography. I am stimulated to ask this question on the basis of "Shall we do sensitization tests on patients in whom cholangiograms are contemplated?"

One objection to the use of lipiodol is the pressure necessary to inject the common duct tube by the T-

tube Very recently a patient—a surgeon brother-in law of mine—wandered afar and had a common duct stone removed His surgeon wished to know the caliber of his common duct I did a cholangiogram, using lipiodol He objected, due to the pressure necessary and asked that I instill 5 c.c. of neopax by gravity I did, and I did not precede it by a test for sensitivity The patient suffered a tremendous reaction, with a fearful outpouring of bile, shock, and prostration

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Epipericardial Fat Shadows in Differential Diagnosis¹

JOHN F. HOLT, M.D.

Ann Arbor, Mich.

AS ANY ONE WHO has seen an appreciable number of autopsies can testify, the accumulation of sizable quantities of adipose tissue outside the pericardium of obese individuals is a commonplace occurrence. It is also common knowledge that these epipericardial fat pads frequently are visible roentgenologically along the left heart border, at times completely obliterating the left cardiophrenic angle. What is apparently not so widely recognized is the fact that large extrapericardial fat deposits occasionally produce well defined roentgenographic shadows adjacent to the right heart border. In this location they sometimes present particularly difficult diagnostic problems.

The literature on the subject of pericardial fat is widely scattered and surprisingly meager. As long ago as 1910, Schwarz (1) described the frequent fluoroscopic observation of triangular shadows of increased density obscuring the left cardiophrenic angle in some of his obese patients. Because these shadows were less dense than that produced by the heart itself, Schwarz concluded that they represented fat tissue, a fact which he repeatedly confirmed at autopsy.

A few additional references to Schwarz's observations followed (2, 3, 4), and then, in 1936, McGinn and White (5) re-emphasized the importance of recognizing epipericardial fat deposits to avoid errors in roentgenologic estimation of heart size. During the same year, Kautz and Pinner (6) stated that "after reviewing a large roentgenologic material and evaluating the very few observations in the literature, we reached the conclusion that under certain circumstances extrapericardial fat bodies may be visualized roentgenologically." These authors then presented the roent-

genologic and anatomic findings in a patient with prominent fat shadows at both cardiophrenic angles and listed some of the intrathoracic conditions with which these fat bodies might be confused.

Our current interest in right epipericardial fat deposits is largely centered around the problem they present in photofluorography. The opportunity to view literally thousands of chest roentgenograms afforded by the increasingly popular mass survey methods employing miniature film has made the roentgenologist acutely aware of a number of insignificant normal variations in the appearance of intrathoracic structures. At times, some of these findings are extremely difficult to distinguish from clinically important lesions. The wide anatomic and physiologic variations in the size and shape of the heart, the frequent unexplained accentuation of the undivided portion of the pulmonary artery or of peripheral vascular markings in the upper portions of the lungs, and the startling prominence of the innominate artery buckled outward by a tortuous thoracic aorta, are just a few of many examples which might be mentioned. In our experience, however, no roentgenologic finding has proved more annoying or more troublesome than an occasionally encountered homogeneous shadow of increased density at the right cardiophrenic angle. This shadow may show considerable variation in size and shape, but in general it is roughly triangular or ovoid, with its outer margin well defined and somewhat convex. We believe that the majority of these shadows represent deposits of epipericardial fat, although such is not always the case.

In an attempt to gain some idea of the incidence of these confusing shadows,

¹ From the Department of Roentgenology, University of Michigan, Ann Arbor. Radiology of the American Medical Association, San Francisco, July 1946.

Read before the Section on

56,000 routine admission 35-mm photofluorograms were reviewed. This number represents approximately one-half of the admission chest films made at the University Hospital during the past five years. In 380 instances a right median base shadow meeting the above description and warranting further investigation was encountered. The incidence figure expressed in percentages (0.6 per cent) is certainly not impressive, but it should be remembered that large-scale survey methods have elevated chest roentgenography into the realm of subastronomical figures and, therefore, it is the actual number of patients found that is important.

Although it is obviously impossible to discuss the findings and final disposition of this entire group of 380 patients, several deserve particular attention from the standpoint of differential diagnosis.

CASE 1 J. M. (514222) In January 1943, a pear-shaped shadow of increased density at the right median base was found on a routine check-up photofluorogram of a University Hospital employee and was reported as a significant lesion. Subsequent fluoroscopy and 14 × 17-inch roentgenograms of the chest entirely confirmed the photofluorographic findings, showing a clearly defined tumor in the right cardiophrenic angle (Fig. 1, A). The mass pulsated, but as it was intimately associated with the right heart border, the pulsation was thought to be transmitted rather than expansile in nature. A lateral projection showed the mass to be located far anteriorly in the chest, apparently attached to the chest wall (Fig. 1, B). Its posterior border was smoothly margined and had a well defined convexity.

The patient, a woman of 47 years, was well nourished but certainly not obese, weighing only 118 pounds. She had no symptoms or physical signs referable to the chest, and her general health was excellent. Nevertheless, exploratory thoracotomy was advised on the grounds that, for those very reasons, the operative risk was small and the chance of complete removal of a possibly malignant tumor was excellent. Accordingly, the operation was done and the tumor proved to be a lobulated mass of pale yellow fat tissue measuring 7 × 5 × 5 cm. The surgeon's note stated that the fat projected from the lowermost junction between the anterior costal pleura and the pericardium, being covered by the pericardial pleural reflection. Histologic section of tissue removed at operation showed it to be "adipose tissue identifying a serous surface." The patient made an uneventful recovery, and subsequent

chest films showed that the previously described shadow at the right median base had disappeared.

Comment It is extremely gratifying to have access to this particular case. The operative findings furnish definite proof that an innocent fat deposit can be present between the pericardium and mediastinal pleura, producing a smoothly margined shadow which, roentgenographically, has the appearance of a significant intrathoracic tumor. Furthermore, the findings in this patient provide an adequate explanation for at least some of the similar annoying roentgenographic shadows which have been observed repeatedly at the right median base in the course of photofluorography. In fact, one's initial inclination may be to dispose of all such shadows as unimportant incidental findings on the basis of a single frontal projection of the chest, thus saving both the patient and physician time and expense. In this regard, utmost caution should be exercised. Experience will show that the solution to the problem of epipericardial fat shadows is not quite so simple. This point is perhaps best illustrated by the following case.

CASE 2 M. H. (187694) This patient, a very obese woman, 63 years of age, entered University Hospital in April 1943 for treatment of hypertension. The routine admission photofluorogram showed an abnormal shadow at the median base of the right lung, and additional roentgenologic examination was requested. Regulation size films, including a lateral projection (Fig. 2, A and B), confirmed the presence of a mass which, although considerably larger, had many features in common with that encountered in Case 1. Following a negative bronchoscopic examination, the patient was given a "test of irradiation." When the tumor did not respond to moderate doses of x-ray therapy, thoracotomy was done. At operation a firm mass measuring approximately 7 × 5 cm was found in the anterior mediastinum, lying between the mediastinal pleura and the pericardium. The Department of Pathology reported it to be "a highly malignant spindle-cell sarcoma of neurogenic origin, in other words a *neurofibrosarcoma*." Postoperative recovery was prompt and recent roentgenograms three full years following operation showed the chest to be free of significant disease.

Comment The two patients whose case histories have been briefly summarized

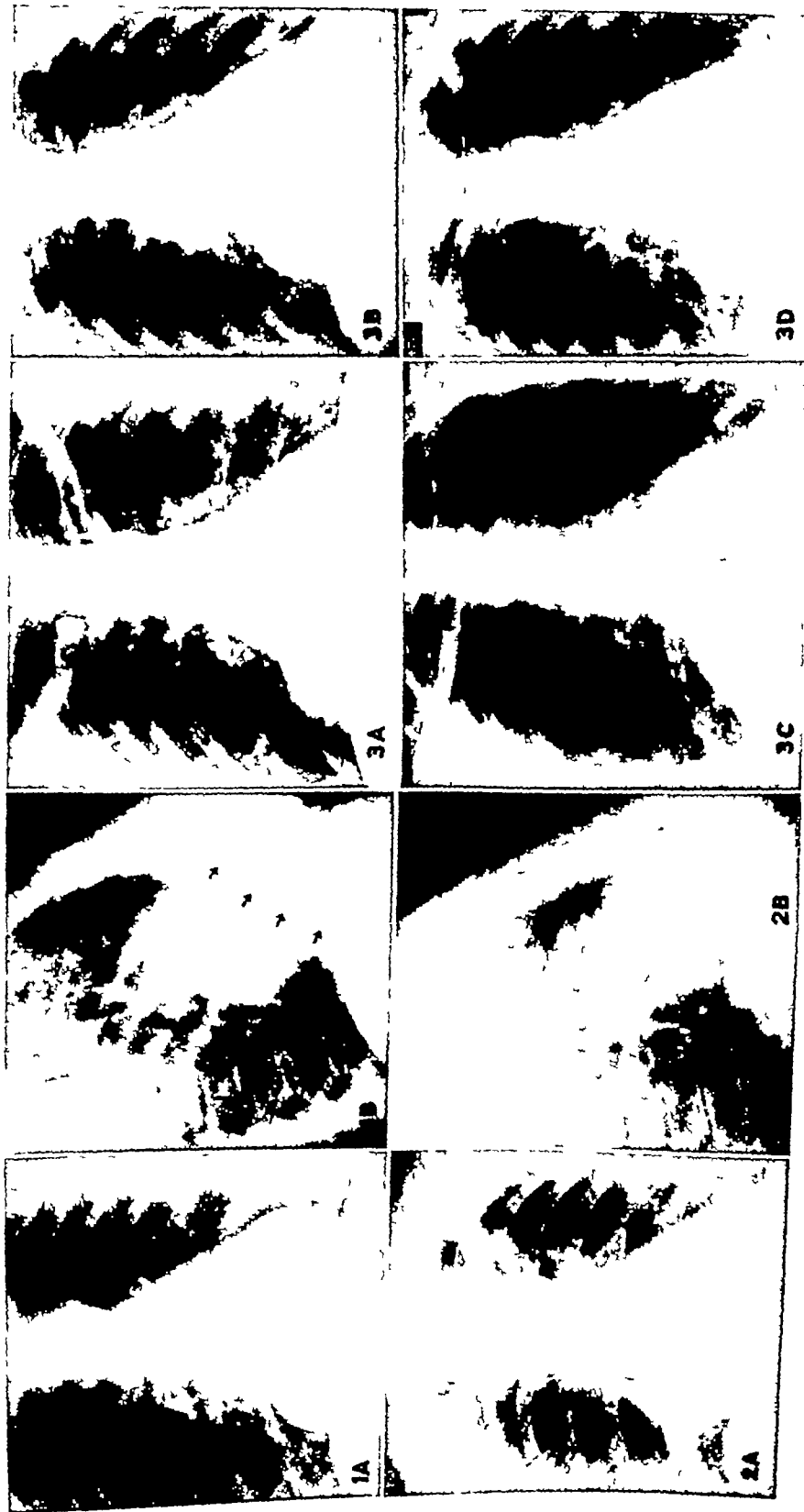


Fig 1 Case 1 Well defined mass at right anterior cardiophrenic angle in relatively thin subject (Postero anterior (A) and right lateral (B) projections) Thoracotomy proved the mass to be an *epipericardial fat deposit*
 Fig 2 Case 2 Abnormal mass adjacent to right heart border of obese patient Mass is similar in many respects to epipericardial fat shadow shown in Fig 1 but at operation a *neurofibrosarcoma* was found Patient is alive and well three years following removal of tumor
 Fig 3 Cases 3-6 Four different cases with similar confusing shadows in right median base anteriorly Although all of these now are thought to represent epipericardial fat pads the original diagnosis in A was *mediastinal dermoid*, in B and C *bronchiogenic neoplasm*

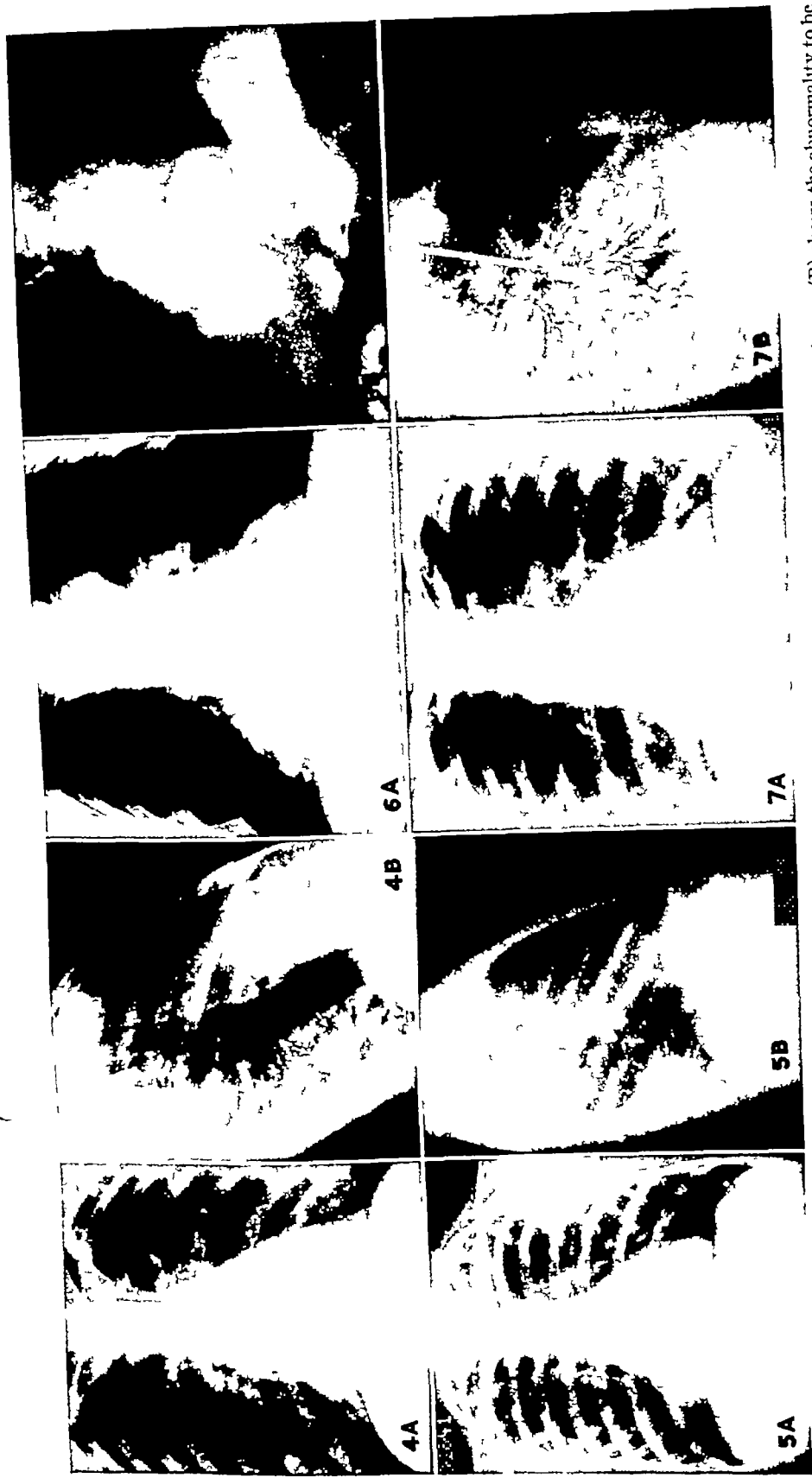


Fig 4 Case 7 Mass at right cardiophrenic angle which in frontal projection (A) resembles fat pad shadow in Fig 1 Lateral view (B) shows the abnormality to be in posterior portion of chest Operation proved it to be a *tracheobronchial cyst*

Fig 5 Case 8 *Subpleural tuberculosis* which in frontal projection (A) closely resembles epicardial fat deposit in Fig 1 Lateral view (B) localized the abnormal shadow to the lower lobe region

Fig 6 Case 10 A Abnormal mass at right cardiophrenic angle strikingly similar in appearance to fat pad shadow in Fig 3, A B Examination of esophagus shows mass to be dilated esophagus resulting from *cardiospasm*

Fig 7 Case 14 Right median base shadow as seen in photofluorogram (A) was thought to be an epicardial fat pad similar to the one on the left side of the heart Bronchogram (B) showed the shadow on the right to represent *atelectasis* of the right lower lobe associated with bronchiectasis

illustrate the two extremes of our problem. Further amplification of the importance of this problem to physician and patient alike is found in the two additional groups of cases which follow.

CASE 3 S R (391248) A 54-year-old man, 68 1/2 inches tall and 167 pounds in weight, registered on the ophthalmology service of University Hospital for treatment of defective vision. His routine admission photofluorogram, dated Nov 23, 1942, showed a mass at the right cardiophrenic angle. Review of this man's record indicated that he had been treated at University Hospital for benign prostatic hypertrophy and pernicious anemia in 1937 and 1938, respectively. In 1939 he returned to the hospital on the thoracic surgery service because chest roentgenograms made elsewhere had shown a "lung tumor." These films were carefully reviewed, and subsequent fluoroscopy, plus frontal, lateral, and oblique roentgenograms, were obtained. All showed the mass to be at the right median base, far anteriorly in the chest (Fig 3, A). The pulsation observed fluoroscopically was thought to be transmitted from the heart. To rule out the possibility of hepatic tumor pushing up the diaphragm anteriorly, pneumoperitoneum was done. This procedure showed the mass to be entirely within the chest, and the final roentgenologic impression was mediastinal dermoid cyst. Thoracotomy was advised but was refused by the patient.

Comparison of chest films made in 1939 and those made in 1942 shows no change whatever in the appearance of the shadow at the right cardiophrenic angle. Furthermore, the patient had no symptoms referable to his chest when last seen, Feb 25, 1946.

CASE 4 F C (525043) A 68 year old woman came to the hospital in May 1943 for treatment of a "lung tumor" which had been discovered on a pre-employment chest roentgenogram elsewhere (Fig 3, B). The patient had been refused employment on the basis of this x ray finding despite the fact that she felt perfectly well. Her admission photofluorogram at University Hospital was supplemented by fluoroscopy and films in various projections, the final roentgenologic impression being intrathoracic neoplasm of indeterminate type. Despite negative bronchoscopic examination operation was urgently advised, but the patient could not be convinced that such procedure was necessary. She sought medical advice elsewhere and x ray therapy was prescribed. From July 29 to Aug 31, 1943, she received 2,100 r to each of three 10 X 10-cm ports directed toward the "tumor." Subsequent chest films have failed to show any appreciable change in the appearance of the mass over a period of almost three years. The patient is alive and well.

CASE 5 B D A 56-year old woman had chest roentgenograms dated Nov 5, 1943, which

were made elsewhere and brought to University Hospital for review. Eleven years previously, a diagnosis of bronchiogenic neoplasm had been made on the basis of roentgenographic findings and intensive radiation therapy had been given. Previous films had been destroyed, but available reports clearly indicated that the suspected "bronchiogenic neoplasm" was located at the right median base and that the x ray therapy had produced no change in the appearance of the chest (Fig 3, C).

CASE 6 A B (474170) A 51-year old woman some 50 pounds overweight entered University Hospital in July 1945, for treatment of deformities resulting from rheumatoid arthritis. She had no chest symptoms and on physical examination the cardiorespiratory system was thought to be normal. The admission photofluorogram of the chest, however, showed a large tumor at the median base of the right lung. Additional films confirmed this finding and localized the mass to the anterior cardiophrenic angle (Fig 3, D). Fluoroscopy showed transmitted pulsation and slight respiratory movement of the mass which, despite its large size, appeared particularly radiolucent in frontal projections. Examinations of the esophagus and entire gastro intestinal tract were negative.

Observation rather than operation was advised in this instance, and check up roentgenograms six months later (January 1946) showed no change. The patient has lost considerable weight during the past five months and, interestingly enough, the mass at the right cardiophrenic angle apparently has decreased in size. If this observation is accurate, it may be of some diagnostic value.

Comment In retrospect, we are of the opinion that the first three patients in this group (Cases 3, 4, and 5) have large epipericardial fat pads rather than the serious abnormalities originally diagnosed. In the case of the fourth patient (Case 6), an original diagnosis of fat pad was made chiefly as the result of previous experience, despite the very large size of the mass.

Before discussing additional points in differential diagnosis, another group of patients is worthy of consideration.

CASE 7 M H (562958) A 23 year old woman had a right median base shadow discovered when chest roentgenograms were obtained because of a slight cough. In frontal projection a pear shaped mass closely resembling the fat pad shadow observed in Case 1 was seen, but a lateral view showed it to be located far posteriorly in the chest (Fig 4, A and B). Thoracotomy and subsequent pathological examination showed a *tracheobronchiogenic cyst*.

CASE 8 W H (488216) A child of 7 years had an abnormal finding at the right cardiophrenic

angle (Fig 5, A) closely resembling the fat pad shadow in Case 1. Lateral projection once again was extremely helpful, localizing the abnormality to the posterior portion of the right lower lobe (Fig 5, B). Review of the record in this case indicated that the child had had known apical tuberculosis for three years. Roentgenograms exposed two months previously had revealed parenchymal infiltration in the right lower lobe. Interval films showed rapid coalescence of this infiltration into a homogeneous, smoothly circumscribed mass, thought to be a *subpleural tuberculoma*.

CASE 9 F H (250398) The patient was a graduate nurse, age 23, whose confusing right median base shadow appeared in 1935 at a time when her tuberculin reaction changed from negative to positive. Roentgenograms the previous year were negative. By 1940, the shadow at the right cardiophrenic angle had been replaced by a small, round, densely calcified scar, clearly identifying the lesion as *primary tuberculosis*.

CASE 10 A A (509111) Discovery of a large pear-shaped shadow of increased density at the right cardiophrenic angle on the admission photofluorogram of a 70 year-old man prompted further investigation. Examination of the esophagus with the aid of barium showed a severe degree of *cardiospasm*. The dilated lower esophagus projected into the right side of the chest (Fig 6, A and B), producing the shadow which so closely resembles epipericardial fat deposition.

CASE 11 B L (272382) An obese woman, 51 years of age, was admitted to University Hospital for treatment of carcinoma of the cervix. Her routine chest photofluorogram showed a triangular shadow adjacent to the right heart border, and although it was thought to be epipericardial fat, additional films were requested. A peculiar area of decreased density subsequently seen through the heart shadow proved to be a bubble of air within the stomach, which was partially herniated through the esophageal hiatus. The suspected right epipericardial fat deposit proved to be the medial aspect of the *herniated gastric cardia*.

CASE 12 F K (528187) The cause of vague gastro intestinal complaints in a 57-year-old man was not suitably explained by clinical examination. His routine chest photofluorogram, however, had shown an apparently abnormal shadow at the median base of the right lung, prompting further examination. Regular chest films showed a continuation of this shadow behind the heart, suggesting the presence of diaphragmatic hernia, and barium was fed to prove it. The stomach was found to be in the normal position, and the mass proved to be a large pulsating *aneurysm* of the descending aorta. Typical erosion of lower thoracic and upper lumbar vertebrae in addition to a four plus Kahn reaction clinched the diagnosis.

CASE 13 W B (500319) A rounded shadow of increased density at the right cardiophrenic angle of a 13-year-old boy was overlooked in January 1943. The configuration of this shadow, as seen in frontal projection, closely resembled an epipericardial fat pad, and, furthermore, a lateral view localized it to the anterior portion of the chest. Three months later, roentgenograms of the chest showed pronounced increase in size of the shadow in question, thus furnishing conclusive evidence of its serious nature. As a diagnosis of lymphoblastoma had been made previously on the basis of cervical lymph node biopsy, it was assumed that the rapidly growing chest tumor represented an intrathoracic manifestation of this disease. This assumption was adequately confirmed by prompt disappearance of the mass following a moderate amount of x-ray therapy.

CASE 14 E B (488531) A 48-year-old woman entered University Hospital with complaints of cough and sputum for the previous four years. The admission photofluorogram of the chest showed a small, triangular, fat-pad-like shadow at the right cardiophrenic angle. With the assistance of additional roentgenograms, bronchography, and bronchoscopy, this finding, originally thought to be of questionable significance, resolved itself into atelectasis and bronchiectasis of the median basilar segment of the right lower lobe (Fig 7, A and B).

Comment Single postero-anterior roentgenograms of the chest in each of these last eight patients (Cases 7 to 14) presented a shadow of increased density at the right cardiophrenic angle very similar to the epipericardial fat shadows previously described. In every instance, however, further examination resulted in identification of lesions which were of real concern to the patient. Usually a lateral roentgenogram of the chest was all that was necessary to establish the presence of significant intrathoracic disease.

We have observed a number of other important lesions resembling epipericardial fat deposits, which might well be added to those already described. Metastatic neoplasm, eventration and other anomalies of the diaphragm, diaphragmatic tumor, paraspinal effusion following splanchnicectomy, rotoscoliosis, and even a large hypertrophic osteophyte constitute a portion of the list. Upward retraction of the medial aspect of the right hemidiaphragm incident to fibrotic tuberculous scarring in the apex of the right lung also should be mentioned.

Mazer (7) recently has reported an operatively proved case of true pericardial diverticulum, the roentgenologic appearance of which was virtually indistinguishable from epipericardial fat. He suggests cardiac aneurysm or neoplasm and encapsulated pericardial effusion as additional entities to be considered in the differential diagnosis.

It is obvious, then, that the problem of differential diagnosis of one of these right median base shadows resolves itself into the following question: "Is this an unimportant, incidental observation to be dismissed lightly or is it a finding of real importance to the patient?"

The major responsibility of supplying the answer to this seemingly fair question appears to lie squarely upon the shoulders of the roentgenologist. Admittedly, unequivocal evidence of an epipericardial fat deposit, short of thoracotomy and direct examination of the offending mass, is difficult if not impossible to obtain. As exploratory operations are always undesirable if less drastic means of diagnosis can be satisfactorily employed, it behooves us to weigh very carefully the various procedures which might be helpful in the final evaluation of these patients.

First of all, we believe it inadvisable to attempt a roentgenologic diagnosis of a suspected epipericardial fat deposit on the basis of its appearance in a single postero-anterior projection of the chest, especially if that single projection is on miniature film. Frontal and lateral roentgenograms of regulation size should always be obtained and, in certain instances, fluoroscopy and oblique projections will be helpful.

The size, shape, and density of the shadow in question should be carefully analyzed. Epipericardial fat pads vary considerably in size and, although exceptions have been encountered, reach their largest proportions in obese individuals. In any given patient, the size of the fat pad may vary in direct proportion to over-all changes in body weight.

As has been shown, the shape of a right-sided fat pad is neither consistent nor en-

tirely characteristic. In frontal projection it most frequently assumes a triangular configuration, the outer margin of which is somewhat convex. In lateral view, the fat pad invariably is located at the anterior costophrenic sulcus, and the extremities of its smoothly margined, bow-shaped posterior border appear to fuse gently with the anterior chest wall. Significant intrathoracic lesions in the lower portions of the lungs seldom have this appearance and are more apt to be posterior in position.

Fat is considerably less dense than other soft tissues, but unfortunately when it is projected against a background of air-containing lung, this ordinarily useful differential in density is lost to a considerable degree. At times, in frontal projection, the pericardial pleura can be seen as a fine linear shadow of increased density around the lateral margin of the more radiolucent fat deposit, yet this is by no means a constant finding. Comparison of fat pad density with that of the heart is not very satisfactory because of the marked difference in thickness of the two structures.

Complete examination of the gastrointestinal tract, including barium enema, should be done at times to rule out possible herniation of the stomach or colon through the anterior portion of the diaphragm. Omental hernia in the same location is supposedly associated with localized upward displacement of the mid-transverse colon.

Bronchography and bronchoscopy may be of assistance if there is reason to suspect a bronchiogenic neoplasm or middle lobe atelectasis from some other cause.

In the final analysis, perhaps the most useful diagnostic agent in dealing with these confusing right median base shadows is the passage of time. Periodic check-up examinations are advisable even when the evidence at hand is overwhelmingly against the presence of dangerous pulmonary or mediastinal abnormality.

SUMMARY

For a long time, roentgenologically visible accumulations of epipericardial fat

have been classically associated with the left side of the heart. Less well recognized but even more bothersome is the occasional occurrence of similar fat pads along the right lateral margin of the cardiac shadow. In this position, the fat deposits, which are located between the pericardium and the pericardial pleura, may assume large proportions and simulate significant intrathoracic lesions. The entire matter is one which presents trying diagnostic difficulties that have been most troublesome to us in the course of admission chest surveying. Specifically cited cases indicate that one cannot afford to identify all triangular or ovoid shadows at the right cardiophrenic angle as epipericardial fat deposits. Consequently, many persons having innocent lumps of adipose tissue attached to the right side of the pericardium

must of necessity be subjected to extensive examination.

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Cardio-Esophageal Relaxation as a Cause of Vomiting in Infants¹

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PERSISTENT OR recurrent vomiting in the newborn or young infant occurs as a frequent problem in pediatric care. This disturbance may be produced by a variety of causes that need not be enumerated here. A large percentage of cases are due to parenteral factors and are usually not subjected to radiologic examination. There remain a considerable number of patients in whom, because of the repeated and significant nature of the vomiting, roentgenologic examination is warranted. Among this group we have observed, in the past three years, 12 patients who exhibited persistent vomiting evidently due to relaxation or dysfunction of the hiatus portion of the esophagus with failure of the normal "sphincter" action of the cardia. In only one instance have we seen this condition beyond the neonatal period. This was in a boy of four who had vomited many feedings and many meals since birth. Berk (2) has reported the case of an adult with a similar clinical and radiographic picture. Because in many respects the condition appears to be the opposite of achalasia of the esophagus, we frequently have referred to the persistent relaxation as "chalasia."

The etiology of this condition is not certain, and one can only speculate as to its probable cause. The normal hiatus esophagus does not gape, but is closed by the pinchcock action of the diaphragm (4). One could postulate that this type of persistent relaxation might be the result of failure of the pinchcock mechanism to function adequately, due to failure of proper development or to imbalance of neuromuscular control. The sphincter-like muscular tonicity at the level of the diaphragm must be relaxed to allow the

passage of food into the stomach, but if an appreciably relaxed state is allowed to remain, there will be a reflux of gastric contents into the esophagus and regurgitation will result. The cardiac sphincter is kept normally closed. The nervous control of the cardia is such that vagal stimulation or sympathetic inhibition results in relaxation of the cardia, while vagal inhibition or sympathetic stimulation produces contraction. The tone of the cardia may also be inhibited by mild stimulation of the gastric mucosa or by sensory impulses arising in the mouth and pharynx. If, as has been postulated, achalasia or cardiospasm may be produced by sympathetic-parasympathetic imbalance, there is no reason to doubt that the same forces operating in the opposite direction may result in chalasia or relaxation of the cardia. Indeed, the surprising thing is that it has not been observed more often. As there have been no deaths in this series, we have not had the opportunity to observe whether there is any visible failure or lack of development to account for this difficulty.

The clinical story is usually well defined. The disease is seen with equal frequency among both male and female infants. The patient almost invariably starts vomiting within a week after birth, usually during the first few days of life. The vomiting becomes progressively worse and soon occurs with each feeding. The infant appears otherwise well and hungry. Regurgitation or vomiting is rarely forceful, almost never projectile, and the vomitus does not contain bile although it may contain visible gastric secretions. Vomiting may take place during a feeding, especially when air is expelled, but is most apt to occur when the child is put back in his

¹ From the Departments of Radiology and Pediatrics, Harvard Medical School, and from the Departments of Roentgenology and Pediatrics of the Infants and Children's Hospitals, Boston, Mass. Presented at the Thirtieth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-6, 1946.

crib in the supine or decubitus position. None of our patients has had significant associated anomalies, although in one infant who had a typical history lasting for five months hematemesis developed and a bleeding hemangioma was subsequently found a small distance above the cardia. All the cases were studied intensively as to other possible causes of vomiting, and no abnormalities were discovered. Un-



Fig 1 J T male infant Moderate relaxation of the cardia Stomach pyloric canal and duodenum are normal

treated, the infant gains slowly even over a period of months, and the more severe cases in the newborn show no weight gain or even a slight loss. Physical examination reveals nothing unusual other than varying degrees of malnutrition.

The diagnosis of cardio-esophageal relaxation depends almost entirely on an adequate fluoroscopic examination of the swallowing function, esophagus, and stomach. A sufficient quantity of barium for adequate visualization is mixed with the infant's formula, or with 5 per cent



Fig 2 R D, female infant Extreme relaxation of the hiatus esophagus Retrograde filling during inspiration

glucose, and the mixture is administered from an ordinary nursing bottle with nipple. The barium-filled esophagus usually appears larger than usual and gives the impression of being thin-walled and relatively flaccid. Esophageal peristalsis is nearly always diminished in strength and frequency. Some relative narrowing of the hiatus esophagus is observed, but there is persistent failure of the "pinchcock" or "sphincter" action to come into play, so that the esophagus appears as a rather flaccid tube leading to the cardiac end of the stomach. During the inspiratory phase of respiration the esophagus dilates and frequently will fill with barium from the stomach, as there is no obstructing mechanism to prevent regurgitation of the gastric contents. With expiration, the filled esophagus is compressed, some of the barium passes again into the stomach and some is regurgitated into the mouth. Occasionally this regurgitation induces a gag reflex followed by true vomiting. Unless this occurs, the changes usually



Fig 3 L W female infant Moderate relaxation of cardia Filling of esophagus produced by slight pressure upon the abdomen



Fig 4 Baby S, male infant Normal emptying of stomach but with moderate cardio-esophageal relaxation

associated with true vomiting, such as contraction of the diaphragm, reverse peristalsis, and strong contraction of the stomach, do not occur. When the patient is in the supine position, even slight pressure upon the abdomen will produce retrograde filling of the esophagus with air or barium from the stomach. An increase in intra-abdominal pressure from crying or struggling will produce a similar result. If the patient is observed in the erect position, no regurgitation takes place, although it is usually evident that the hiatus esophagus is open, as frequently one can observe air passing into the esophagus from the stomach. It is probable that the hiatus portion of the esophagus does not remain patent at all times, but the persistent relaxation is easily recognized.

Treatment of this condition has been empiric. The patients are fed in the sitting or erect position and maintained in this position for thirty minutes after the feeding has been accomplished. Mild variations of this syndrome may need no more

therapy than this, and certainly most pediatricians have encountered infants who regurgitate easily but need no more in the way of corrective measures than this simple technique. In a certain number of cases so corrected some variant of *chalasia* may be the basic difficulty. Again, we have all seen infants who had appreciable regurgitation until they assumed the erect position in the normal sequence of their growth and development.

In the presence of well defined, persistent relaxation we have, in addition, kept the infant propped up and maintained in a semi-sitting position in its crib throughout the day and night. This has been accomplished by the use of pillows and a semi-harness for support. Formula feedings were thickened with one ounce of cereal to 15 ounces of formula to achieve a heavier mixture, which would be less likely to reflux up through the relaxed cardia. No drugs were employed.

On such a regime all of the infants stopped vomiting almost immediately and showed good weight gain and normal development. This regime was carried on easily for several months at home. We have had the opportunity to examine a number of the patients several months

after the original diagnosis was made, and at that time they have shown no abnormalities on physical or fluoroscopic examination and were able to carry on in a perfectly normal fashion

SUMMARY AND CONCLUSIONS

(1) Persistent relaxation of the hiatus esophagus is an important but rather infrequent cause of vomiting in the newborn or young infant

(2) Twelve patients with this condition have been seen during the past three years

(3) The clinical picture of persistent regurgitation that can be alleviated when the patient is placed in the erect position suggests the diagnosis

(4) The diagnosis can be made with certainty only by fluoroscopic examination. Retrograde filling of the esophagus during inspiration or with increase in intra-abdominal pressure with persistent relaxation of the hiatus esophagus is diagnostic

(5) The condition appears to be, in the majority of instances, a temporary aberration of the neuromuscular function of the hiatus portion of the esophagus and diaphragm

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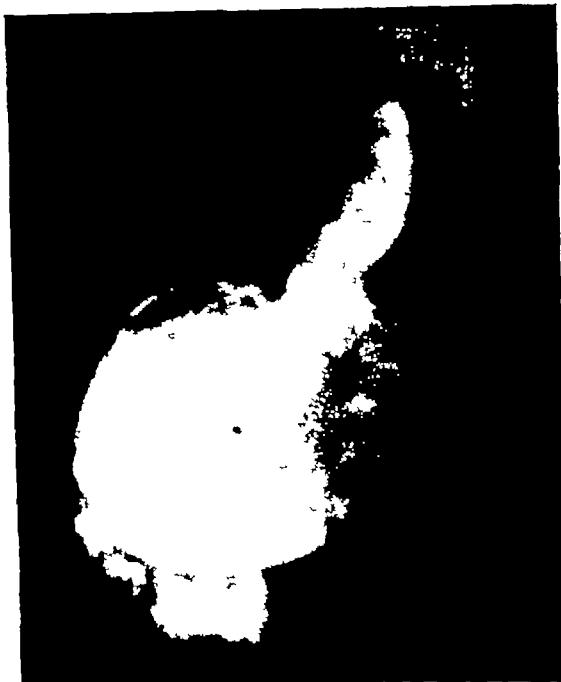


Fig 5 S R male infant. Severe cardio-esophageal relaxation. Entire esophagus shows dilatation and retrograde filling with inspiratory effort

DISCUSSION

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Regurgitation in infants to us fathers and some of us grandfathers is a common experience. The burping pad of young mothers indicates the frequency of the occurrence of esophageal regurgitation and it takes one with the experience of Dr Neuhauser to pick twelve cases out of two thousand gastro-intestinal examinations in infants, in order to point out to us the existence of a mechanism that might explain our observations in cases of special severity.

It seems to me that Dr Neuhauser has stated the question, has given us the explanation, and has closed the book. There is certainly no point of controversy. We are indebted to him for having brought this matter to our attention and personally at least I believe that I will be a little more tolerant of the pediatrician who is anxious to know if there may be a mechanical explanation or an error in the neuromuscular mechanism as has been suggested by Dr Neuhauser.

Lymphoblastoma

An Evaluation of the Differences in Sensitivity to X-Ray Irradiation of Different Types, and Its Application to a Quantitative Therapeutic Test¹

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IN THIS PAPER an attempt will be made to evaluate the differences in radiosensitivity of the various types of lymphoblastoma, and a plan will be presented for distinguishing between the types by means of a quantitative therapeutic test with x-ray irradiation, when a mass presents itself in the mediastinum or abdomen and no lymph node is available for biopsy

TISSUE SENSITIVITY IN GENERAL

It is a well established fact that different tissues respond with different degrees of sensitivity to irradiation. Bergonié and Tribondeau established the axiom that cells are most sensitive in their embryonic state. Normal cells that are less differentiated respond more quickly than those that are adult in type. This apparently depends on the presumption that less differentiated cells have a greater power of reproduction and the fact that cells are most sensitive to irradiation during their mitotic stage.

The response of neoplastic tissues to irradiation is governed by the same factors. Since neoplastic tissues are rapidly growing, they show a high degree of mitotic activity and hence are more sensitive to irradiation. Other influences, however, come into play. As Kaplan (6) has pointed out, the response of neoplastic tissue to irradiation depends, also, on (a) the condition of the patient, (b) the position and situation of the lesion, (c) the extent of invasion, and (d) the bed of the tumor, its nutritional supply and vascular system, all of which are essential to tumor growth.

Most observers agree that the lympho-

cyte and its predecessor, the lymphoblast, are the most sensitive cells in the body. It should be recalled, moreover, that the adult lymphocyte is the end product of a series of more immature cells comprising the lymphocytic series. It would be logical to assume that the more immature cells of the group, the lymphoblasts and prolymphocytes, would be most sensitive.

Bearing in mind these general remarks, the individual radiosensitivity of lymphoblastomas will be classified and discussed.

TYPES OF LYMPHOBLASTOMA AND THEIR RELATIVE RADIOSENSITIVITY

The lymphoblastomas may be classified as follows:

- 1 Giant follicular lymphadenopathy
- 2 Lymphatic leukemia
- 3 Lymphosarcoma
- 4 Polymorphous-cell sarcoma
- 5 Hodgkin's disease

1 Giant Follicular Lymphadenopathy

While giant follicular lymphadenopathy is not essentially a malignant lymphoblastoma, it has been included in this group because, according to an estimate by Symmers (11), as many as 20 per cent of the cases may undergo transformation into polymorphous-cell sarcoma, Hodgkin's disease, or leukemia. Rubenfeld (10) has demonstrated the extreme radiosensitivity of this condition, effecting not only control but probably cure with individual x-ray doses of 100 to 150 r to the involved lymph nodes or spleen, and total doses ranging from 300 to 1,200 r measured in air. The factors he used were 200 kv, 10 to 20 ma, 0.5 mm Cu + 1.0 mm Al, at distances

¹ From the Radiation Therapy Department (Dr. Ira I. Kaplan, Director), Bellevue Hospital, New York. Accepted for publication in August 1946.

of 40 to 50 cm. Histologically, the lymph nodes in this condition are characterized by a numerical and dimensional hyperplasia of the lymph follicles, which are delimited by a zone of deeply staining small lymphocytes. The germinal areas are made up of large hypochromic embryonal cells and relatively deeply staining small embryonal cells of the large lymphocytic type. Although these cells are not malignant, they are embryonic in type. This fact may explain the extreme degree of sensitivity. The absence of malignancy explains the permanence of cure.

2 *Lymphatic Leukemia* Lymphatic leukemia is characterized by the appearance in the blood stream of immature lymphocytes (prolymphocytes). In the acute forms, even lymphoblasts are present in the blood. Widmann (15) and Haden (5) have pointed out that leukemia is not necessarily accompanied by an abnormal number of white blood cells. One third of Haden's cases did not have an elevated count.

There is usually a generalized enlargement of the lymph nodes, although certain groups may be affected to a greater extent than others. Histologically the lymph nodes show complete replacement of the normal structure by immature lymphocytes of all types. Occasionally these cells are seen to invade the capsule and even neighboring structures.

Lymphatic leukemia is extremely sensitive to small doses of radiation, resembling giant follicular lymphadenopathy in this respect. The patient, however, usually succumbs to the disease. Irradiation causes the associated symptoms to subside, but the disease eventually recurs, thus demonstrating its malignancy. Irradiation is, therefore, only palliative, not curative.

The differential diagnosis of lymphatic leukemia from the other lymphoblastomas lies in the demonstration of abnormal cells in the blood stream. Even in so-called aleukemic leukemia, careful and repeated examination of blood smears will eventually establish the diagnosis.

At times, in a certain significant number of cases, as emphasized by Symmers (12), this disease may be represented by a preponderance of enlargement of the abdominal and/or thoracic lymph nodes, or spleen. Under these conditions, with an aleukemic blood picture, differentiation from other lymphoblastomas may present a problem.

3 *Lymphosarcoma* Lymphosarcoma is characterized by the malignant proliferation of one of the lymphocytic series of cells. Kundrat, according to Symmers, predicated a tendency on the part of the process to confine itself within more or less sharply defined limits, but noted its proclivity to expand locally and often ruthlessly. Of Symmers' 17 cases of lymphosarcoma encountered at necropsy in Bellevue Hospital, 9 were locally limited, while 8 showed expansion and invasion of neighboring tissues. In 70 of a series of 100 cases reported by Kundrat, Ghon and Roman, MacCallum, and Symmers (12), lymphosarcoma occurred preponderantly or "primarily" in the deeper structures, including, in the order of their frequency, the gastro-intestinal tract, thymus, abdominal nodes, spleen, and thoracic nodes. In the remaining 30 cases, the following lymph nodes were predominantly involved: cervical in 14, superficial structures of the gastro-intestinal tract, including pharynx, tonsils and mouth, in 12, inguinal and axillary nodes and prostate, 4.

Three types of lymphosarcoma are recognized, according to the predominant cell—the small-cell lymphosarcoma, large-cell lymphosarcoma, and reticulum-cell lymphosarcoma. Perhaps the last named type, arising, as the term implies, from the reticulum cells in the germinal centers and parenchyma of the lymph node, is not strictly a lymphosarcoma, in view of the fact that the relationship of the reticulum cell, if any, to the lymphocyte is not definitely known (12).

The radiosensitivity of the lymphosarcoma is well recognized. Theoretically, it is possible to determine a difference in sensitivity between the small-cell and the large-cell types, the latter, being the



Fig 1 A Prominent mediastinal tumor on left side. On the same day that this film was taken, 300 r, measured in air, were delivered through a 10×15 -cm port. The dose was repeated the next day. Factors were 200 kv, 20 ma, 50 cm TSD, 0.5 mm Cu + 1.0 mm Al filter, HVL 0.9 mm Cu.

B Film taken on the fifth day following the beginning of treatment, showing almost 50 per cent reduction in the size of the mass. This response is typical of lymphosarcoma or giant follicular lymphadenopathy. Leukemia with a mediastinal mass may also respond in this way. In this case therapy was continued to 1,800 r in daily doses of 300 r, with practically complete disappearance of the mass.

The patient was a 44-year-old white male who entered Bellevue Hospital in February 1946, complaining of intermittent fever, malaise, and weakness of two months' duration. He was found to have a 4-plus Wassermann reaction. In the hospital he had several bouts of fever of $103-104^{\circ}$ F, accompanied by a macular rash over the trunk, which disappeared during the remissions, which lasted seven to ten days. He had inguinal and axillary adenopathy. The liver and the spleen were not felt at first, but in June and July both were found to be enlarged. Roentgenograms of the chest were at first interpreted as showing aneurysm of the ascending aorta. Courses of penicillin and sulfadiazine had no effect on the clinical course. Two lymph node biopsies showed chronic lymphadenitis. Blood counts and sternal puncture were normal, except for an increasing anemia. The white blood count became depressed under the influence of roentgen therapy to the lymph nodes and to the retroperitoneal area. The fever receded following therapy to the retroperitoneal area. The axillary and inguinal lymph nodes disappeared following irradiation. Agglutination tests of all types were negative. At the present time the patient is running a low grade temperature, is symptom free except for weakness, shows a recession of lymph nodes and the mediastinal mass, and has a slightly enlarged liver and spleen. It seems probable that the diagnosis is lymphosarcoma, which has been brought under temporary control by irradiation.

younger or more embryonic of the two, should be more radiosensitive. Clinical control and differentiation, however, combined with adequate pathological studies have not been easily possible. As to the reticulum-cell variety, the fact that its cell of origin is more of the connective-tissue type may explain the observation that in any given series of cases of lymphosarcoma there are usually a few that prove to be more radioresistant than the others. Perhaps this cell variety belongs more properly with the polymorphous-cell sarcomas, to be described later.

Because of its radiosensitivity, lympho-

sarcoma may be held in check for varying periods of time with comparatively small doses of radiation. With one or two doses totaling 200 to 600 r measured in air, delivered at 200 kv, 20 ma, with a filter of 0.5 mm Cu and 1.0 mm Al, a mediastinal or abdominal mass large enough to give severe pressure symptoms, will diminish in size as much or more than 50 per cent in a period of three or four days, thereby bringing about striking relief of symptoms. In spite of this notable response, however, sooner or later, whether because of local invasiveness or because of metastases or multiple neoplastic foci,

lymphosarcoma often breaks its bounds and is no longer controllable by irradiation

4 *Polymorphous-Cell Sarcoma* Polymorphous-cell sarcoma was first described by Symmers (13) in 1938, in presenting clinical and histologic studies showing the capacity of giant follicular lymphadenopathy to undergo direct transformation into this disease, having multiple foci of origin in hyperplastic lymph follicles. Apparently the disease is derived from a proliferation of cells which eventually rupture from a large follicle. Morphologically the large hypochromatic or shadow cells are traceable through smaller transitional cells into still smaller hyperchromatic cells which resemble large lymphocytes. Symmers chose to employ the term polymorphous-cell sarcoma rather than lymphosarcoma until more conclusive evidence should be found that the unit of growth is the lymphocyte. The lymph nodes in this disease are slow growing in contradistinction to those in either Hodgkin's disease or lymphosarcoma. Rubenfeld (10) has demonstrated that this condition is relatively radioresistant. It differs in this respect from the extremely radiosensitive lymphosarcoma. In Rubenfeld's cases, doses of 1,300 to 2,500 r measured in air were necessary to cause recession in size or disappearance of the involved lymph nodes.

It may be postulated that the relative radioresistance of polymorphous-cell sarcoma may be attributable to its cell composition. Since the exact derivation of the offending cell is not known, and since indeed the relationship of the cell to the true lymphocyte is in doubt, it may be reasonable to assume that its radioresistance is due to a possible origin from the supportive tissues of the lymph node rather than the true lymphocytic germinal center. In this respect, it resembles the so-called reticulum-cell lymphosarcoma.

5 *Hodgkin's Disease* This well known, but not well understood, disease is characterized by generalized involvement of the lymphoid and reticulo-endothelial system, including the spleen, by a character-

istic pathological process. Clinically the disease is usually pictured as beginning in the cervical lymph nodes, with gradual extension to the other lymphoid structures of the body, accompanied by increasing weakness, anemia, and occasionally intermittent fever, often of the Pel-Ebstein type. Desjardins (2, 3) has pointed out the clinical importance of the retroperitoneal lymph nodes and the great variety of symptoms which their involvement in Hodgkin's disease can cause. Symmers (12) has shown the high percentage (63 per cent) of cases in which the abdominal lymph nodes or the combined abdominal and thoracic lymph nodes are predominantly involved.

According to Newell (8), Hodgkin's disease is never purely local. He bases his statement on the fact that he has never succeeded in curing a case, however early the treatment was begun, and has never seen a case cured by surgical extirpation of the group of enlarged nodes.

Microscopically, Hodgkin's disease is characterized by the replacement of the normal lymph node structure by what is apparently a hyperplasia of the reticulo-endothelium (1). One of the most noteworthy features is the pleomorphic cytology, in which respect the condition differs from lymphosarcoma. Mononuclear and multinuclear giant cells (Dorothy Reed or Sternberg) are characteristic. Lymphocytes, plasma cells, neutrophilic and eosinophilic polymorphonuclears may all be present, the eosinophils being particularly characteristic, though not invariably present. There is a notable increase in reticulum, which appears as coarse straight fibrils. Fibrosis may be marked in late cases and, according to Graef (4), is characteristically present even in early stages. Necrosis is sometimes seen, particularly in the spleen.

Most observers have found that, of all the lymphoblastomas, Hodgkin's disease is probably the most refractory to radiation therapy. The response of involved nodes or masses depends, however, a great deal on their position and upon the stage of the

disease In general, the superficial lymph nodes will respond to relatively mild doses of x-ray radiation, up to 1,000 r Deep-seated masses, on the other hand, as shown by Wolpaw *et al* (14) in a discussion of intrathoracic Hodgkin's disease, often require as much as 2,000 to 3,000 r measured in air to cause regression

THERAPEUTIC TEST WITH IRRADIATION AND ITS PRACTICAL APPLICATION

The various types of lymphoblastomas discussed above, as has been pointed out, show, in general, definite though not marked differences in radiosensitivity In most cases, the problem of diagnosis is easily solved by the careful histologic examination of an excised lymph node In the case of lymphatic leukemia, a blood smear will usually suggest the diagnosis

As Symmers and Desjardins have demonstrated, however, the various types of lymphoblastoma not infrequently invade a deep-lying group of nodes or mass of lymphatic tissue, either intrathoracic or abdominal, with little or no involvement of superficial lymph nodes In such an event, a lymph node may not be available for biopsy Hence a presumptive diagnosis will have to be arrived at in another way

It is conceivable that even lymphatic leukemia, in an aleukemic form, may involve predominantly the deeper lymphoid structures The problem of diagnosis in such a situation may be a perplexing one Wyckoff (8), however, states that he has never found a case of aleukemic leukemia in which intensive search of the slides did not give information, or at least a strong presumption, of the ultimate development into frank leukemia Hence it is believed that an aleukemic leukemia presenting predominant enlargement of internal lymphoid structures can be eliminated from our diagnostic problem It is to be recommended, however, that every case presenting such a picture should have a careful blood study to rule out leukemia Moreover, sternal puncture and marrow smear examination will often aid in making the diagnosis

Although giant follicular lymphadenopathy has usually been described as a clinical entity characterized by generalized enlargements of the superficial lymph nodes with or without splenomegaly, Symmers (12) has reported one case recorded by Terplan and one by himself, in three known necropsies, in which the retroperitoneal nodes were enlarged to an enormous extent while there was little or no enlargement of the superficial nodes In the third case, also, the retroperitoneal nodes were enormously enlarged, but there was some enlargement of the nodes in the neck and groin as well Hence giant follicular lymphadenopathy must be considered along with lymphosarcoma, polymorphous-cell sarcoma, and Hodgkin's disease when a patient presents himself with clinical or roentgenologic evidence of a mass in the mediastinum or abdomen

It is not within the scope of this paper to discuss the differential diagnosis between the lymphoblastomas and other conditions which may present themselves in the form of mediastinal or abdominal masses Let it suffice to mention those conditions which must be differentiated In the mediastinum a group of malignant neoplasms may occur which are sensitive only to large doses of radiation Of those, reticulum-cell sarcoma, endothelioma, and embryonal spindle-cell sarcoma may fall into the same classification of radiosensitivity as the more resistant Hodgkin's disease Other malignant tumors are fibro sarcoma, melanosarcoma, carcinoma of the thyroid and thymus, teratoma, neurogenic sarcoma, and certain esophageal and bronchiogenic carcinomas These are practically insensitive to radiation, although some degree of response may occur after large doses (7, 9) In the latter event, the mass almost inevitably re-expands Benign tumors include dermoid cysts, fibroma, lipoma, neuroganglioma, chondroma, and sarcoid Masses simulating tumors are mediastinal abscess, encysted pleural fluid, echinococcus cyst, and aneurysm It may be mentioned that the thymus may be involved primarily or pre-

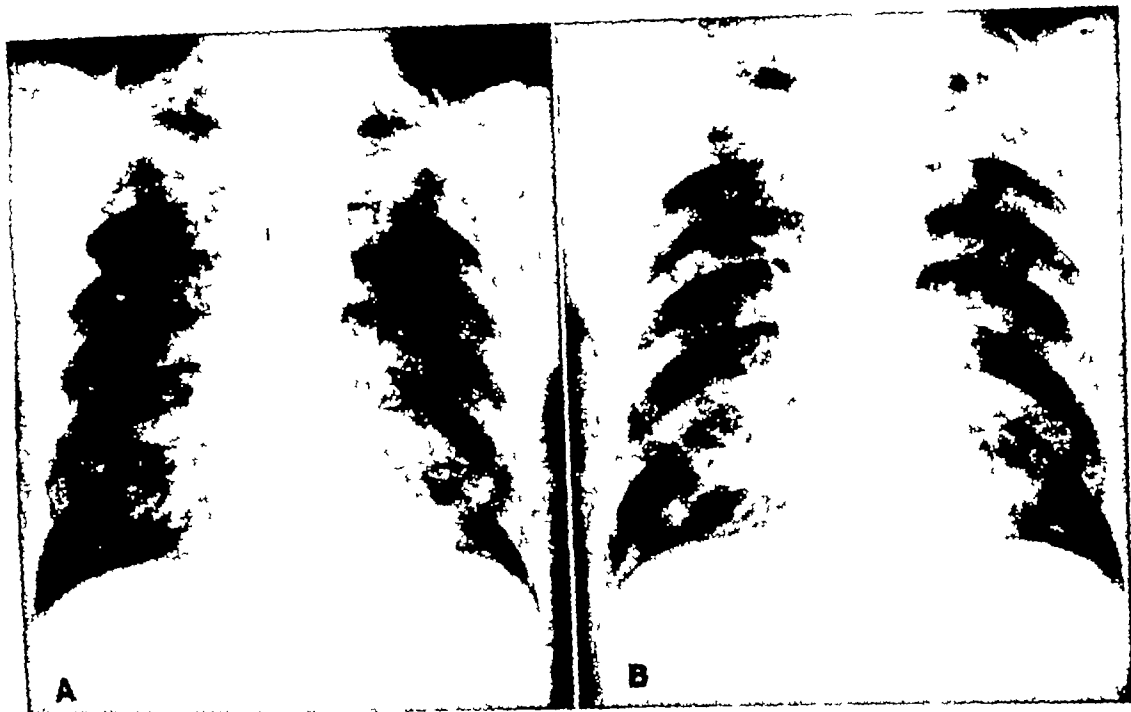


Fig 2 A Small mass projecting from the right side of the mediastinum

B Appearance of mass following 200 r to each of two posterior ports, and 400 r to each of two anterior ports each 10×15 cm. Factors were 200 kv, 20 ma, 50 cm TSD 1.0 mm Cu + 1.0 mm Al filter HVL 1.4 mm Cu. The mass has decreased in size about 25 per cent.

The patient was a 48-year-old white male who was first seen in our clinic in January 1941, with an enlarged lymph node 4×5 cm, at the angle of the right jaw, a preauricular node 2×2 cm, several smaller anterior cervical nodes, and a large node, 4×4 cm, in the right axilla. The pathological report on nodes removed from the left axilla and left inguinal region showed a giant follicular lymphadenopathy. The preauricular and submandibular nodes responded excellently to a total of 600 r in divided weekly doses of 150 r. The axillary nodes practically disappeared following administration of a total of 450 r in divided weekly doses of 150 r.

In April 1941 the patient returned with swelling of the left lower extremity, several small nodes in both inguinal regions, and a hard fixed node in the region of the previous biopsy incision in the left inguinal region. It was thought that these findings represented a sarcomatous change, and 2,600 r were given in daily doses of 200 r to each inguinal region. The nodes subsided.

In September 1941 there was recurrence of bilateral inguinal nodes, with swelling of the left leg. 1,500 r were then given to anterior and posterior ports directed at the left inguinal region, and 1,500 r to the right inguinal area. The nodes again subsided and the general condition of the patient remained fairly good. He returned in July 1944 with enlarged lymph nodes in the left suboccipital area and preauricular regions, right supraclavicular fossa, both axillae, and right inguinal area. Liver and spleen were not palpable. A chest film showed no hilar or mediastinal adenopathy. From July to October 1944, the left preauricular area and both axillae received 2000 r each, and the right supraclavicular and both inguinal areas received 800 r each, followed by recession of the lymph nodes.

The patient was seen in 1945 and was essentially well. He returned in June 1946 complaining of a sore mouth and enlarged nodes in the left submandibular region. There were smaller nodes on both sides of the neck. No lymph nodes were palpated elsewhere. The liver and spleen were not enlarged. The chest film showed a node about 5 cm in diameter extending out to the right from the mediastinum. The submandibular nodes diminished in size 75 per cent as a result of two doses of 200 r each. The mediastinal mass responded as indicated in the films reproduced herewith. In spite of this response, the mouth condition, an aphthous stomatitis, became worse. The patient was admitted to the hospital and placed on penicillin therapy and vitamins. Two days after admission a generalized macular rash developed, which was termed a toxic erythema multiforme by the dermatologist. The general condition became rapidly worse and the patient died one month after his return to us. Autopsy was not obtained.

The course of this case, with the recurrence of lymphadenopathy and the increasing dosage of irradiation needed to control it, suggested polymorphous-cell sarcomatous degeneration of a previously diagnosed giant follicular lymphadenopathy. The response of the mediastinal tumor to 1200 r divided among four ports is believed to be rather typical of a polymorphous cell sarcoma.

dominantly by any one of the lymphoblastomas. In the abdomen conditions to be differentiated from lymphoblastoma are abdominal aortic aneurysm, pancreatic tumor, retroperitoneal lipoma, fibroma or

sarcoma, neurogenic sarcoma, kidney or adrenal tumor, mesenteric cyst. Most of these conditions will be diagnosed from the concomitant symptoms and signs, and, as will be pointed out, by their failure to re-

disease In general, the superficial lymph nodes will respond to relatively mild doses of x-ray radiation, up to 1,000 r Deep-seated masses, on the other hand, as shown by Wolpaw *et al* (14) in a discussion of intrathoracic Hodgkin's disease, often require as much as 2,000 to 3,000 r measured in air to cause regression

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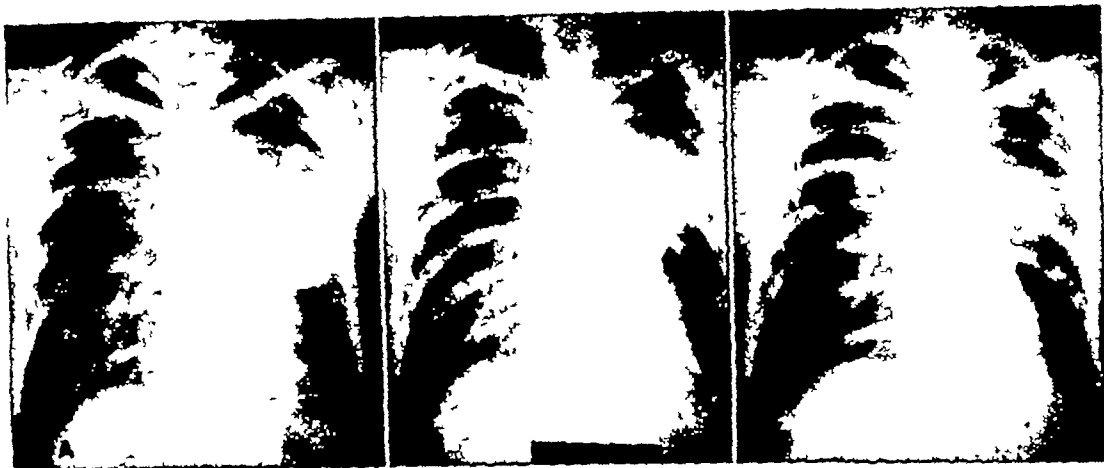


Fig 3 A Large globular mass extending from mediastinum and hilar region into left lung field
 B Reduction of about 25 per cent in size of mass seventeen days after institution of therapy Anterior port (10 X 15 cm) received 1000 r, posterior port received 1200 r

C Eight months later, the mass had diminished in size about 75 per cent In the meantime the anterior and posterior chest received an additional 1000 r each, five months after the original therapy Factors used were 200 kv 20 ma 50 cm T.S.D, 0.5 mm Cu + 1.0 mm Al filter, H.V.L. 0.9 mm Cu

The patient was a 29-year-old white man first seen in our clinic in September 1939, with a history of a mass in the right neck of ten months duration Physical examination revealed enlarged cervical and axillary nodes and some hilar adenopathy In July 1939 excision of three large nodes from the neck was done, and the pathological report showed Hodgkin's disease In September and October 1939, the patient received 2,200 r to the right axilla, 1,200 r to the left axilla, 3,800 to right neck, 2,000 r to left neck, and 1,400 r to mediastinum In December he received 800 r to the left axilla

The patient was not seen from July 1940 until April 1945, when he presented himself with cough and dyspnea Examination revealed a sensation of mass in the right upper quadrant, and a large mass in the left upper chest (A) Therapy was instituted as indicated above The patient was last seen on July 30, 1946, at which time the chest film showed essentially the same picture as in C He felt fine except for some nodular swelling of the left breast, which was thought to represent Hodgkin's involvement

This case is presented to demonstrate, first, the relatively larger doses of radiation needed to bring about some reduction in a Hodgkin's mediastinal mass and, second, to indicate the latent period before further reduction takes place This is a plea to continue the therapeutic test until an adequate dosage has been delivered

therapeutic test and subsequent clinical course indicate that the tumor is one of the other malignant neoplasms, the prognosis is invariably poor Should the tumor be benign, as indicated by complete lack of response to irradiation and relative lack of symptoms or progress, then surgery may bring about a cure

SUMMARY

1 The relative radiosensitivity of the lymphoblastomas has been discussed Arranged according to sensitivity, they are

- A Giant follicular lymphadenopathy
- B Lymphatic leukemia
- C Lymphosarcoma
- D Polymorphous-cell sarcoma
- E Hodgkin's disease

2 The therapeutic test of irradiation has been discussed, and a plan submitted for a presumptive differentiation between giant follicular lymphadenopathy, lympho-

sarcoma, polymorphous-cell sarcoma, and Hodgkin's disease, when these diseases are predominantly limited to the mediastinum or abdomen, and no superficial lymph node is available for biopsy

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spond to moderate doses of x-ray irradiation

In various clinics, and here at Bellevue Hospital, radiation therapists have used the therapeutic test of irradiation to differentiate roughly between a radiosensitive tumor and one that does not respond to irradiation. Reynolds and Leucutia (9) have described a therapeutic test with high-voltage and supervoltage x-rays in an excellent paper, in which all tumors of the mediastinum are placed in four different groups depending on their radiosensitivity. The lymphoblastomas discussed in the present paper fall into groups I and II of that classification.

It is hereby proposed to control the therapeutic test with more care, observe the results with more frequent roentgenographic and physical examinations, and carry it out to a greater degree than has been done heretofore, for the purpose of differentiating between the various types of lymphoblastoma.

The following routine is suggested as applicable to a mediastinal mass, and transposable to an abdominal mass.

1 Pre-radiation x-ray film with measurement of size of mass

2 *First day* 300 r measured in air, directed towards the tumor. Factors 200 kv, 20 ma, 0.5 mm Cu + 1.0 mm Al, TSD 50 cm

3 *Second day* 300 r

4 *Fifth day* X-ray film with measurement of the mass. If the mass has decreased appreciably in size (25 per cent or more), a presumptive diagnosis of either giant follicular lymphadenopathy or of lymphosarcoma is made. Therapy is continued, at the discretion of the therapist, to deliver a tumor-killing dose. Only time will tell the exact diagnosis. If the tumor reappears, or if a tumor appears elsewhere, the chances are that the diagnosis is lymphosarcoma. If the condition is permanently controlled, the diagnosis remains either giant follicular lymphadenopathy or localized lymphosarcoma.

It may be stated that an undiagnosed aleukemic form of leukemia with medi-

astinal mass will respond much the same way at this stage of the test. It is most likely, however, that at this time the blood picture will be altered and hence make the diagnosis more evident. Therapy can be then continued as indicated by the individual variations of the case.

5 If the mass shows no regression in five days, therapy should be continued at the rate of 200 to 300 r per day, an x-ray film being taken every three days. Anterior and posterior ports may be used. If the mass begins to show regression when 1,200 to 2,000 r have been delivered, a presumptive diagnosis of polymorphous cell sarcoma is made. Therapy is continued at the discretion of the therapist.

6 If as much as 2,000 to 3,000 r are required to cause a 25 to 50 per cent decrease in the size of the tumor, a presumptive diagnosis of Hodgkin's disease is made.

7 If there is no response with 3,000 r,* then the tumor is radio-insensitive, and is probably one of those mentioned in the differential diagnosis. It should be remembered, however, that substernal thyroid, enlarged thymus, thyroid carcinoma, thymic carcinoma, fibrosarcoma, melanoma, esophageal and bronchiogenic carcinoma, and sarcoid may show some degree of response to the higher dose.

The importance of the quantitative therapeutic test of x-ray irradiation lies in the evaluation of the prognosis, depending upon the response. With a presumptive diagnosis of giant follicular lymphadenopathy, the prognosis for life is reasonably good. If a presumptive diagnosis of localized lymphosarcoma is made, and the lesion is controlled by irradiation, it may be reasonable to offer a fair prognosis against early recurrence. A presumptive diagnosis of polymorphous-cell sarcoma, with control by irradiation, offers a longer period of life on an average than could be expected with Hodgkin's disease. If the

* These figures are based on the presumption that about 60 per cent of air dose reaches the tumor. Hence 3000 r air dose even using several ports should deliver about 1800 r into the tumor.

Differential Diagnosis of Intracranial Neoplasms by Cerebral Angiography¹

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IN THE DIAGNOSIS of intracranial tumor it is our aim to determine the site of the lesion and its histologic character. The first goal, so important for the surgical treatment, has been attained with a high degree of accuracy by the combined use of various diagnostic methods. The second postulate, viz., the preoperative recognition of the anatomic character of the lesion, is far more difficult to fulfill, yet it has considerable prognostic importance.

Intracranial angiography not only has proved to be a reliable method for the localization of cerebral tumors, but frequently furnishes information as to the pathologic-anatomic type of the neoplasm by demonstrating a specific vascular pattern. In this respect the method is decidedly superior to ventriculography.

Differences in vascularization of cerebral tumors have been known to neuropathologists and neurosurgeons for a long time and have recently been studied by advanced histologic methods (Hardman, 1). In certain neoplasms, differences of vascular design are of such gross nature that they can be demonstrated by angiography.

Egas Moniz (2-5) and his pupils were the first to point out the angiographic features of angiomas, meningiomas, and certain vascular gliomas. They also recognized a conspicuous absence of vascularity in cysts, abscesses, and cholesteatomas. Tönus (6) and Hemmingson (7) described certain changes characteristic for glioblastoma. With increasing angiographic experience, a number of workers have studied the specific arrangement of blood vessels encountered in various types of intracranial neoplasms (Almeida Lima, 8; Lorenz, 9; Egas Moniz, 10; Riechert, 11; Engeset, 12).

In a series of 125 patients with intracranial tumor subjected to angiography at the University of Michigan Hospital, a special vascular pattern was observed in the following groups: angioma, meningioma, glioblastoma, certain types of astrocytoma. It must be emphasized here that a characteristic vascular pattern is not always to be found in such cases, but if it can be demonstrated it may be considered as almost pathognomonic.

ANGIOMA (8 Cases)

Most of the lesions loosely designated as cerebral angiomas in reality are arteriovenous malformations. Although this group has been described in a previous communication (List-Hodges, 13), it will be discussed again to stress the features differentiating it from other intracranial lesions.

In *arteriovenous malformations* (6 cases), one or several enlarged and unusually tortuous arteries lead to a tangle of smaller vessels forming a more or less well defined mass (Figs 1 and 2). From this angiomatous malformation one or more greatly dilated and redundant veins emerge, carrying a mixture of arterial and venous blood (14, 15). The entire vascular malformation, including the venous connections, is shown during the arterial phase of angiography, since the contrast medium enters directly into venous channels through sizable arteriovenous connections within the angioma. Because of this rapid transit of blood, no filling is obtained during the venous phase.

Arteriovenous malformations are found most frequently to involve cortical vessels, especially the anterior or middle cerebral

¹ From the Department of Surgery, Section of Neurosurgery, and the Department of Roentgenology, University of Michigan Medical School, Ann Arbor, Mich. Accepted for publication in June 1946.

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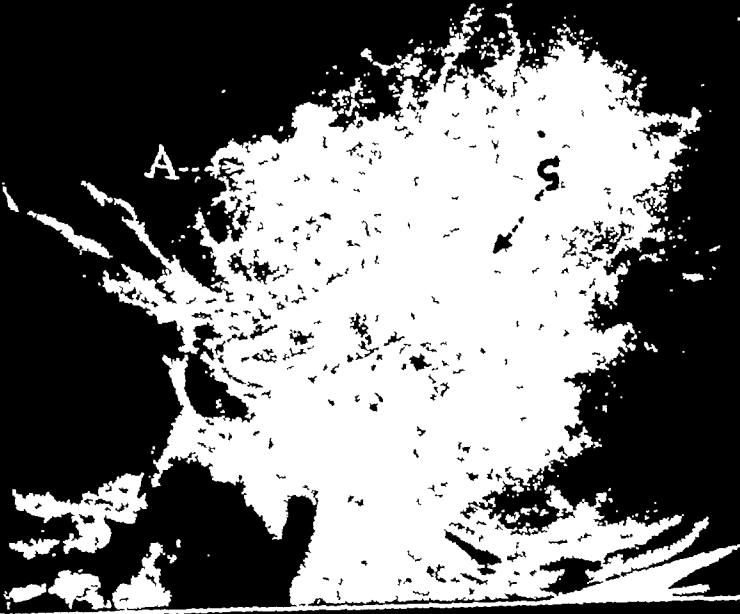
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2A



2B

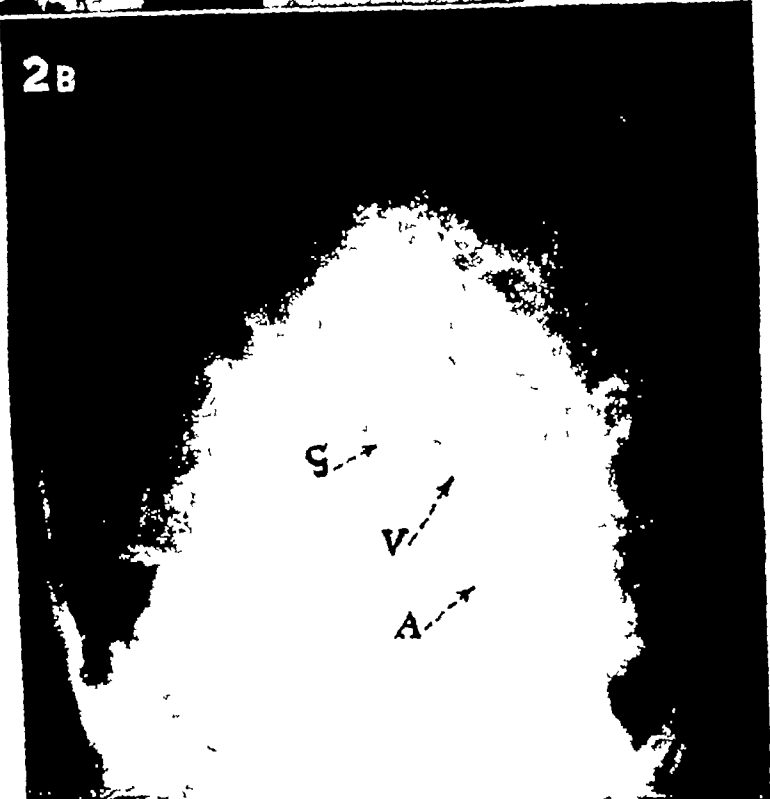


Fig 2 Arteriovenous malformation of the anterior cerebral system. Lateral (A) and anteroposterior (B) arteriograms. An angioma composed of small vessels (A) drains into a large varix (V), which is connected with the vein of Galen (G).

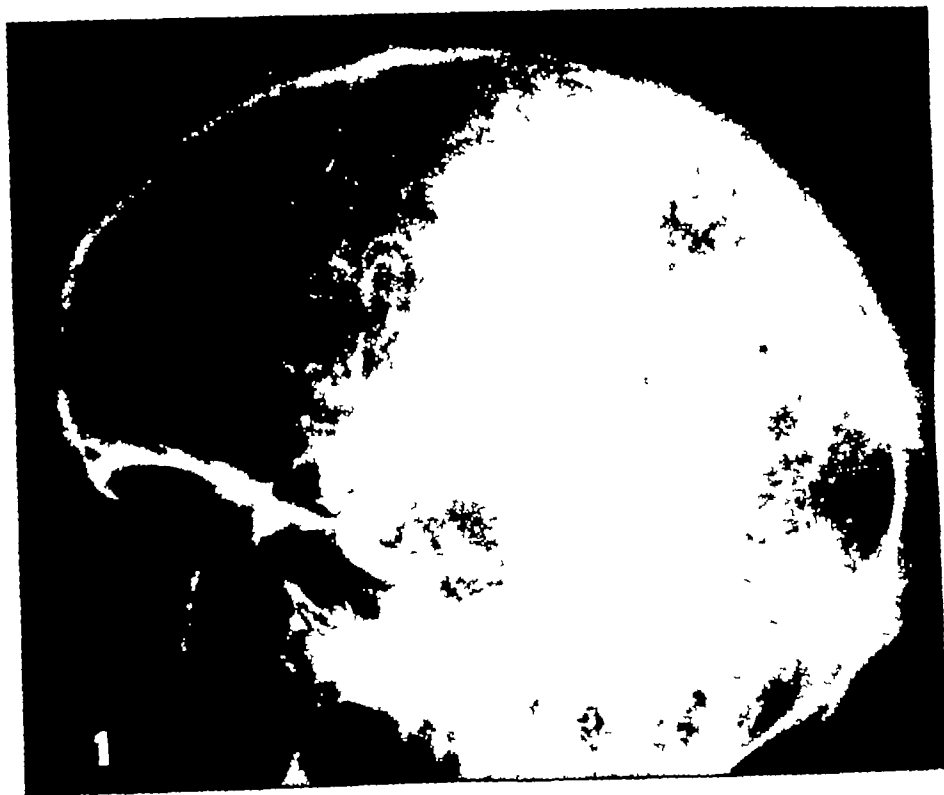


Fig 1 Arteriovenous malformation of rolandic area. Lateral arteriogram. Simultaneous filling of enlarged arteries, capillary angioma and huge efferent vein.

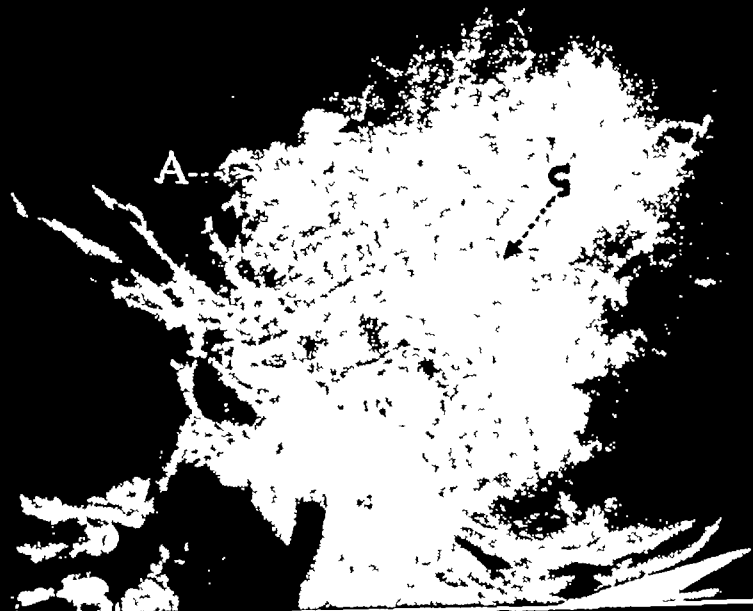
arteries, but they may also affect vessels supplying the interior of the brain (Wyburn-Mason, 16). Bilateral vascular anomalies have been observed (Egas Moniz, 17), particularly, when the lesion is situated close to the mid-line. It is worthy of mention that the internal carotid of the affected side is enlarged and tortuous and occasionally even cardiac enlargement and hypertrophy can be demonstrated (14). In contrast to true neoplasms, even large arteriovenous malformations do not displace the uninvolved cerebral vessels, this is clearly demonstrated on the anteroposterior projection by the absence of mid-line shift of the anterior cerebral artery. Furthermore, angiomatous vessels are far more bizarre in size than those encountered in vascular neoplasms.

Cavernous angiomas of the brain without associated vascular malformation are usually of small size and of rare occurrence. Our angiographic experience with this type

of lesion has been inconclusive and limited to two cases. In one observation the patient suffered from jacksonian seizures and skull x-rays revealed an area of calcification in the frontal region. Angiography was disappointing in that it failed to show any specific vascular alteration. Operation and histologic examination of the excised tissue proved the lesion to be a small cortical cavernous angioma.

In the other case, massive hemorrhage had occurred into a small angioma, producing the clinical picture of right hemiparesis and aphasia. Here, too, angiography was unsatisfactory and, because of the hemorrhage, merely revealed evidence of a space-occupying lesion. Operation disclosed what looked like an encapsulated, partially organized subcortical hemorrhage. In both observations, the pre-existing angiomatous spaces may have been obliterated by clotted blood or thrombosis and, therefore, failed to become visible on angiograms.

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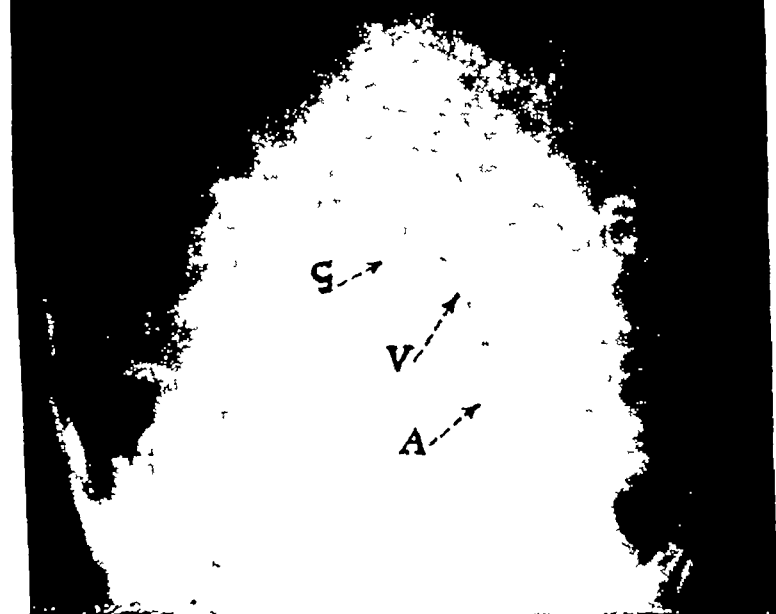


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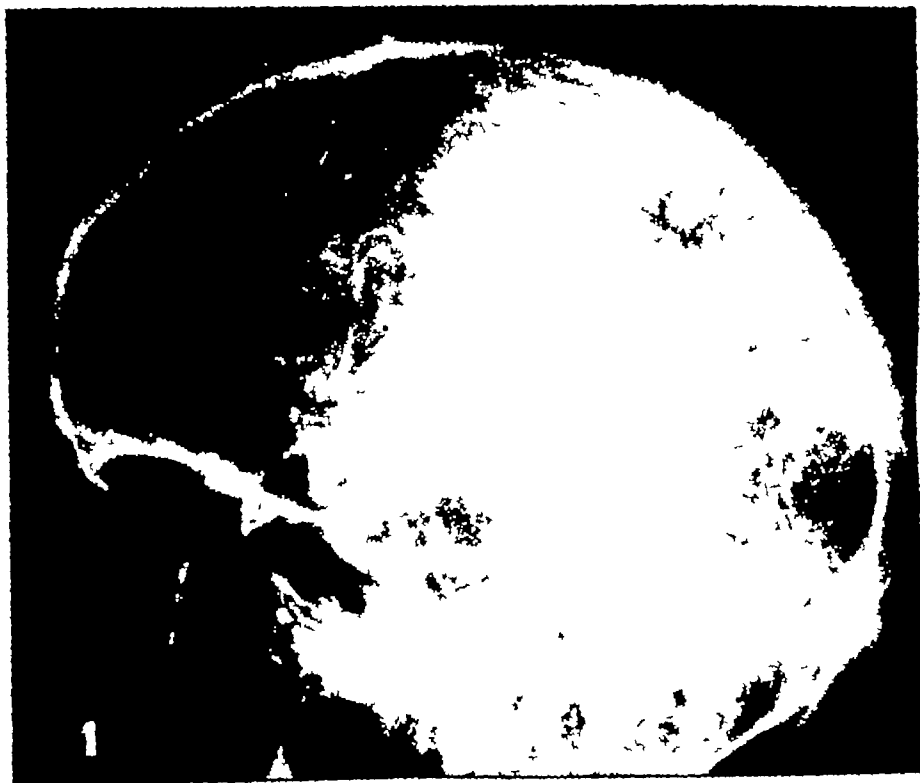


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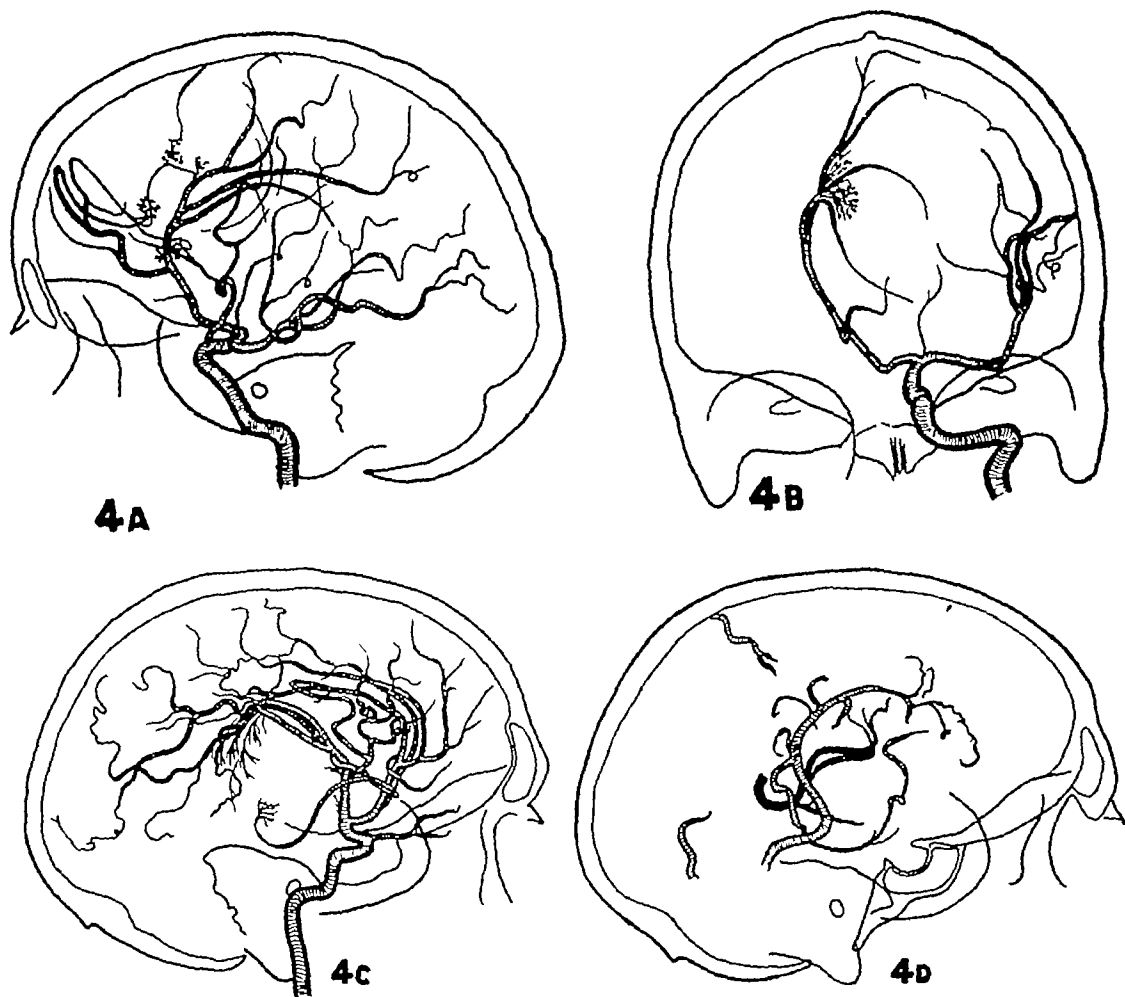


Fig 4 Angiograms of meningeomas (line drawings) showing the characteristic mode of vascular displacement and special blood supply A and B Lateral and anteroposterior arteriograms of a parasagittal frontal meningeoma. Note fine 'flower spray' arteries on the surface and attachment of the tumor C and D Lateral arteriogram (C) and venogram (D) of meningeoma of the lesser sphenoidal wing Fine brush like arteries supply the surface and attachment of the tumor Note characteristic arrangement of surrounding veins

ized displacement of cortical vessels is found in various types of space-occupying lesions, a probable diagnosis of meningeoma can be made when cortical arteries are seen to be displaced away from the inner table of the skull. In frontoparietal meningeomas of the convexity, this may be clearly shown by anteroposterior arteriograms which, indeed, present an optic cross section of the lesion (Fig 3, A and C). In meningeomas of the olfactory groove, on the other hand, the characteristic manner of arterial displacement is best seen on the lateral arteriogram (Fig 9, A).

Meningiomas possess a rich blood supply derived from two different sources (Al-

meida Lima, 8) (1) from the external carotid system and (2) from the internal carotid (and vertebral) system (Fig 5). The external carotid artery provides both an extracranial circulation for the tumor through the internal maxillary and superficial temporal arteries and a dural circulation through the meningeal (especially the middle meningeal) vessels. The supplying meningeal arteries are apt to be enlarged and tortuous, they end in a dendritic cluster of smaller vessels and form buds that perforate the bone at the dural attachment of the tumor. Frequently, this can be recognized on simple films of the skull since the meningeal vessels leave character-

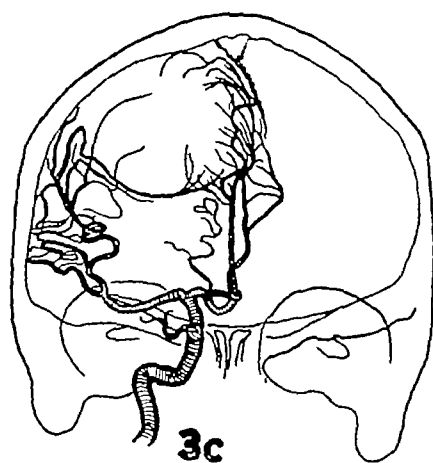
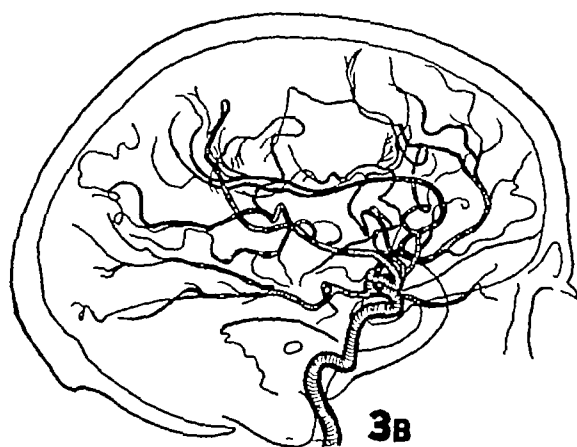
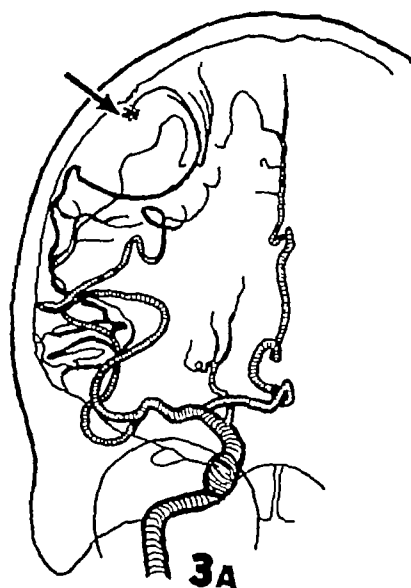


Fig 3 Arteriograms of meningiomas (line drawings) showing the characteristic type of vascular displacement.
 A Anteroposterior arteriogram of small parietal meningioma. Arrow points to dural attachment of tumor.
 B and C Lateral and anteroposterior arteriograms of a parasagittal anterior parietal meningioma.

Intracranial *angioblastomas* occur almost exclusively in the cerebellum (if one disregards the angioblastic meningiomas, to be discussed below). We have had no occasion to examine this type of lesion by angiography.

MENINGIOMA (20 Cases)

The meningiomas possess characteristic features which make them particularly

suited for angiographic diagnosis (3-5, 8-12). Since they are demarcated, often globular tumors, located at the surface of the brain, they cause circumscribed deformities of adjacent cortical vessels. The cortical arteries in contact with the tumor appear to be distended and separated from one another, whereas the arteries of the adjacent compressed brain are crowded together and form a concentrically arranged corona around the lesion. Although local-

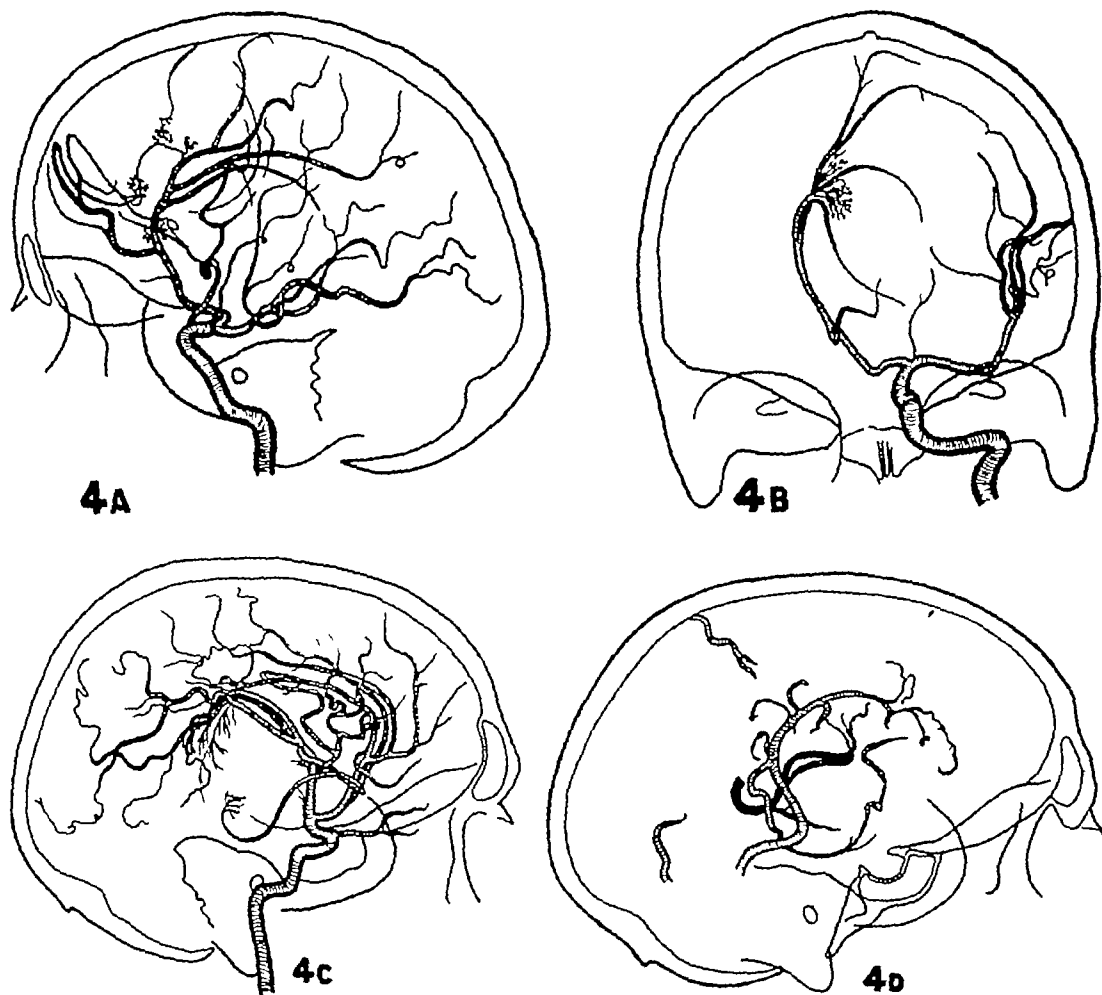


Fig 4 Angiograms of meningeomas (line drawings) showing the characteristic mode of vascular displacement and special blood supply A and B Lateral and anteroposterior arteriograms of a parasagittal frontal meningeoma Note fine "flower spray" arteries on the surface and attachment of the tumor C and D Lateral arteriogram (C) and venogram (D) of meningeoma of the lesser sphenoidal wing Fine brush-like arteries supply the surface and attachment of the tumor Note characteristic arrangement of surrounding veins

ized displacement of cortical vessels is found in various types of space-occupying lesions, a probable diagnosis of meningeoma can be made when cortical arteries are seen to be displaced away from the inner table of the skull. In frontoparietal meningeomas of the convexity, this may be clearly shown by anteroposterior arteriograms which, indeed, present an optic cross section of the lesion (Fig 3, A and C). In meningeomas of the olfactory groove, on the other hand, the characteristic manner of arterial displacement is best seen on the lateral arteriogram (Fig 9, A).

Meningiomas possess a rich blood supply derived from two different sources (Al-

meida Lima, 8) (1) from the external carotid system and (2) from the internal carotid (and vertebral) system (Fig 5). The external carotid artery provides both an extracranial circulation for the tumor through the internal maxillary and superficial temporal arteries and a dural circulation through the meningeal (especially the middle meningeal) vessels. The supplying meningeal arteries are apt to be enlarged and tortuous, they end in a dendritic cluster of smaller vessels and form buds that perforate the bone at the dural attachment of the tumor. Frequently, this can be recognized on simple films of the skull since the meningeal vessels leave character-

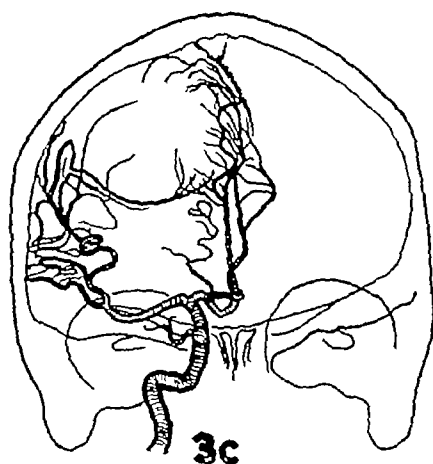
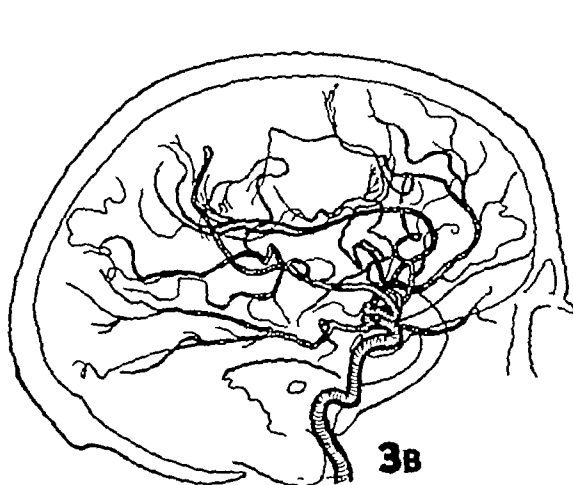
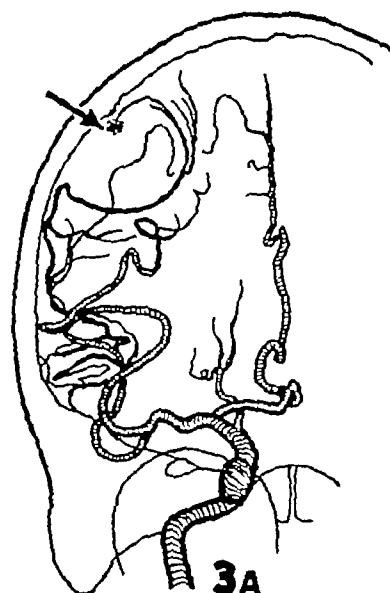


Fig 3 Arteriograms of meningiomas (line drawings) showing the characteristic type of vascular displacement.
 A Anteroposterior arteriogram of small parietal meningioma. Arrow points to dural attachment of tumor.
 B and C Lateral and anteroposterior arteriograms of a parasagittal anterior parietal meningioma.

Intracranial *angioblastomas* occur almost exclusively in the cerebellum (if one disregards the angioblastic meningiomas, to be discussed below). We have had no occasion to examine this type of lesion by angiography.

MENINGIOMA (20 Cases)

The meningiomas possess characteristic features which make them particularly

suited for angiographic diagnosis (3-5, 8-12). Since they are demarcated, often globular tumors, located at the surface of the brain, they cause circumscribed deformities of adjacent cortical vessels. The cortical arteries in contact with the tumor appear to be distended and separated from one another, whereas the arteries of the adjacent compressed brain are crowded together and form a concentrically arranged corona around the lesion. Although local-

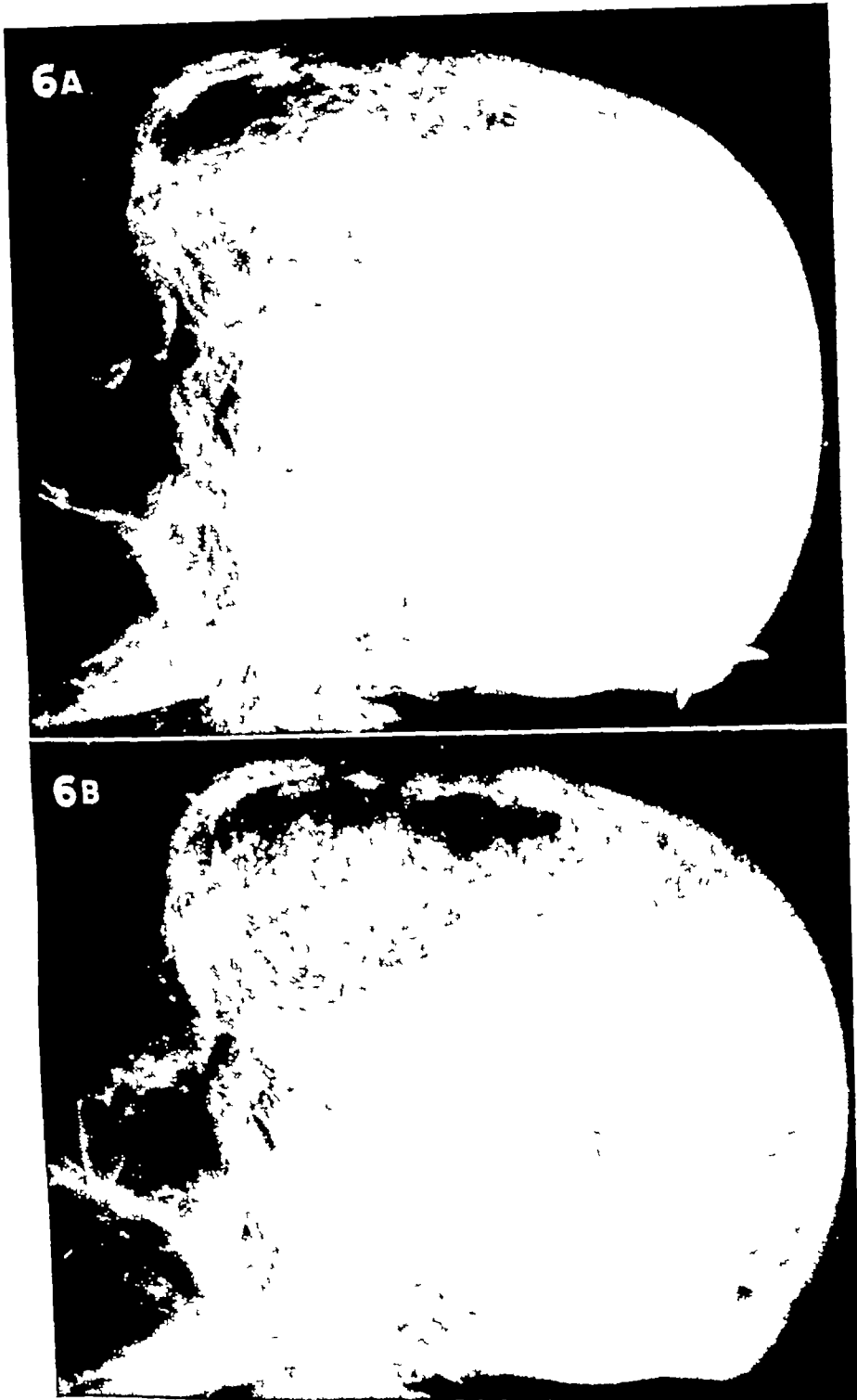


Fig 6 Arteriograms showing the double circulation of a vascular frontal meningioma. A Lateral arteriogram obtained by external carotid injection demonstrating the circulation of the scalp, calvarium, and dura. B Lateral arteriogram obtained by internal carotid injection showing unusually rich vascularization of the tumor. Note also typical displacement of cerebral vessels.

istic negative imprints in the calvarium. A positive image of the dural blood supply of the tumor can be obtained by arteriography of the external carotid artery (Fig 6, A). The method demonstrates not only the vascularization of the skull, but also the finer branches in the dura and neoplasm. The angiographic picture resembles that of the end-arborizations of a nerve in the

show this circulation to the best advantage (Fig 6, B). Besides the normal but displaced cortical arteries, one may observe one or multiple newly formed "tumor vessels," usually rather small arteries, splitting up into fine branches within the substance of the meningioma. The angiographic appearance of these vessels (Fig 4) has been compared with a paintbrush or a flower

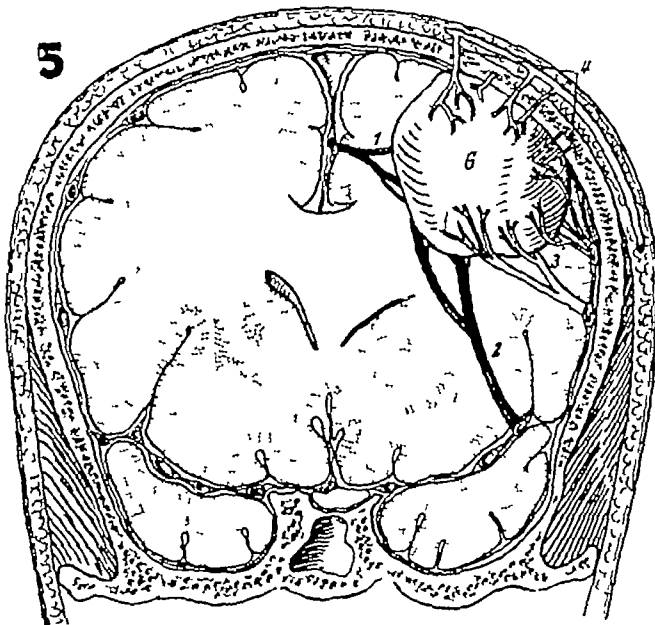


Fig 5 Diagram to show the double blood supply of meningioma reproduced from Egas Moniz. The vessels shown in black are arteries of the internal carotid system (1 anterior cerebral, 2 middle cerebral). Those in white are arteries of the external carotid system (3 middle meningeal, 4 superficial temporal artery). G Tumor

motor end plate. Since the blood supply from branches of the external carotid artery, though variable in extent, is a typical feature of all meningeal tumors (meningioma and meningeal sarcoma), some authors (Almeida Lima, 8, Egas Moniz, 10, Riechert, 11) recommend routine angiography of the common or external carotid artery whenever a meningeal growth is suspected.

The second source of blood supply of meningiomas is the cerebral vessels which, depending on the location of the tumor, are derived either from the internal carotid or, less frequently, from the vertebral system. Arteriography of the internal carotid may

spray (Egas Moniz, 2, Lorenz, 9). Characteristic for meningiomas is the formation of large veins which collect the blood at the tumor capsule and drain into adjacent cortical veins or dural sinuses. On venograms following carotid injection, large but short veins with many tributaries appear to outline the circumference of the growth in a garland or claw-like fashion, with the larger veins being situated in grooves and depressions between nodules of the tumor surface. The veins of the tumor can be distinguished from normal cortical veins by the abnormal course, large caliber, but short length (Figs 4, D and 8, B).

Finally, a typical feature of meningioma

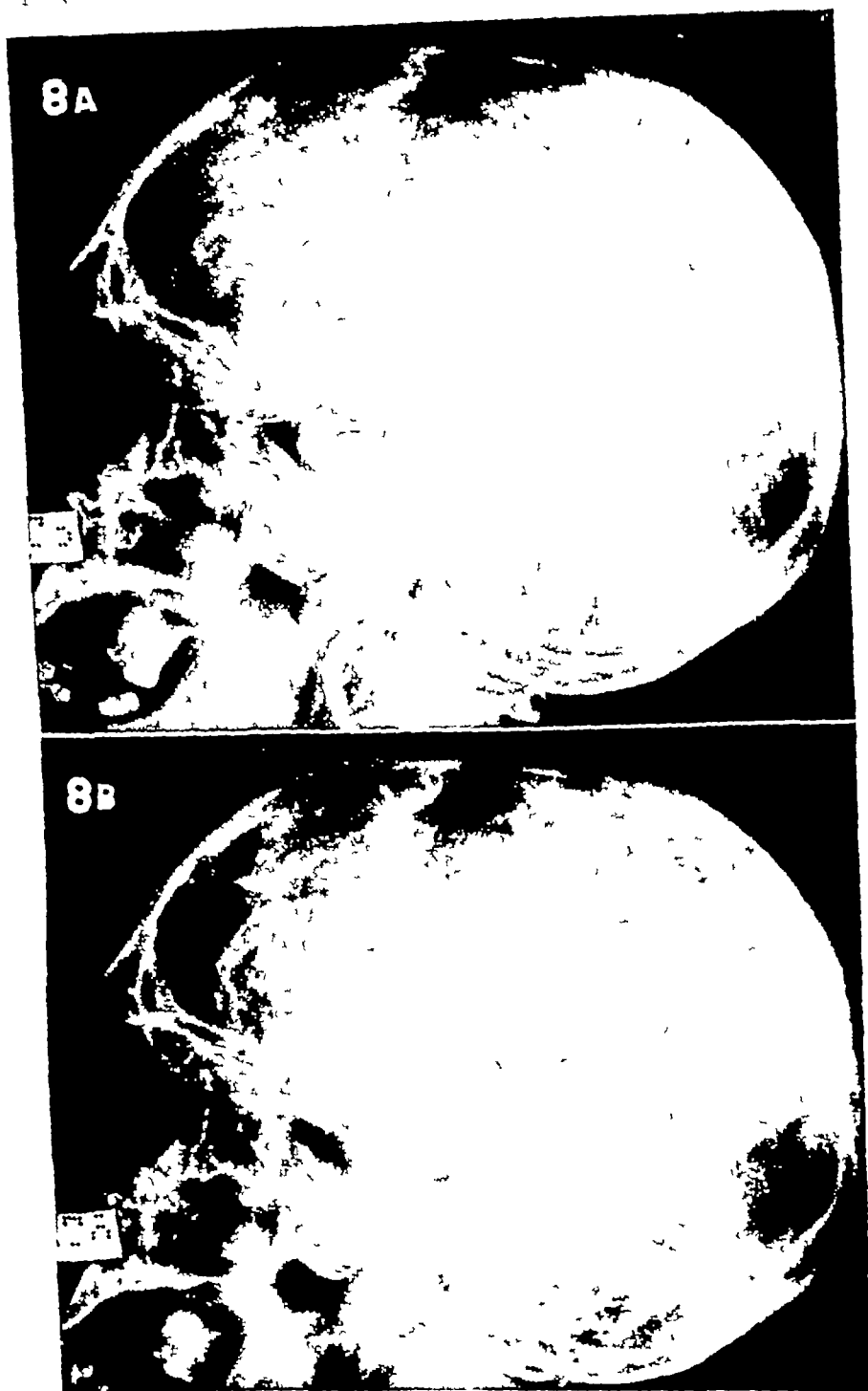


Fig 8 Comparison of arteriogram and venogram in a meningeoma of the lesser sphenoidal wing A Lateral arteriogram showing typical displacement and special vessels at attachment of tumor B Venogram, showing characteristic pattern of veins and diffuse capillary shadow of tumor

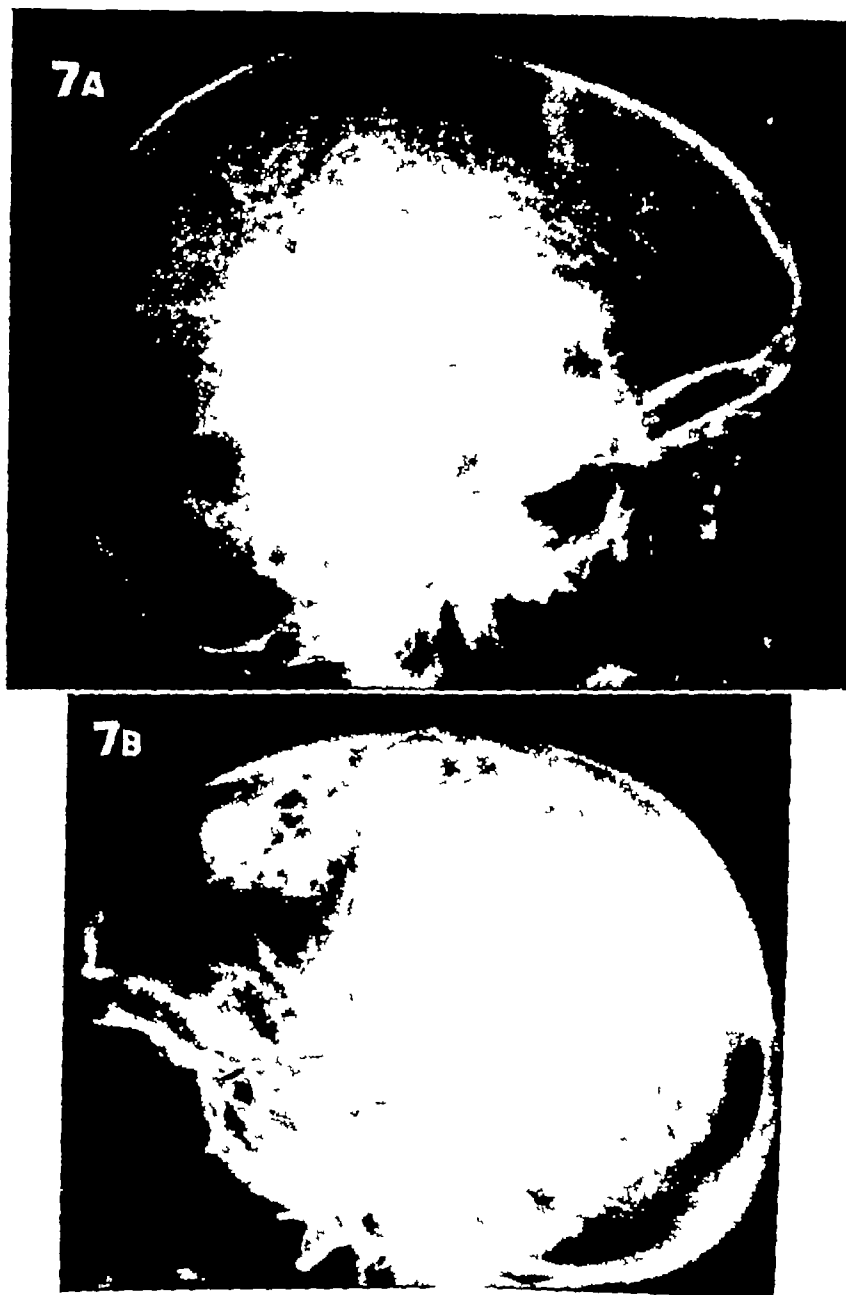


Fig 7 Demonstration of the special capillary pattern in meningioma during the arterial phase A Lateral arteriogram of vascular meningioma of the lesser sphenoidal wing B Lateral arteriogram (common carotid injection) of frontal parasagittal meningioma

is the demonstration of a special vascular network consisting of vessels of capillary or nearly capillary size. In such cases, angiography demonstrates diffuse, uniform, or slightly mottled opacification, silhouetting

parts of the tumor or even the entire growth (Figs 7, 8 B, and 9). The x-ray contrast between tumor tissue and brain is explained by the fact that the capillary circulation within the meningioma is both denser and

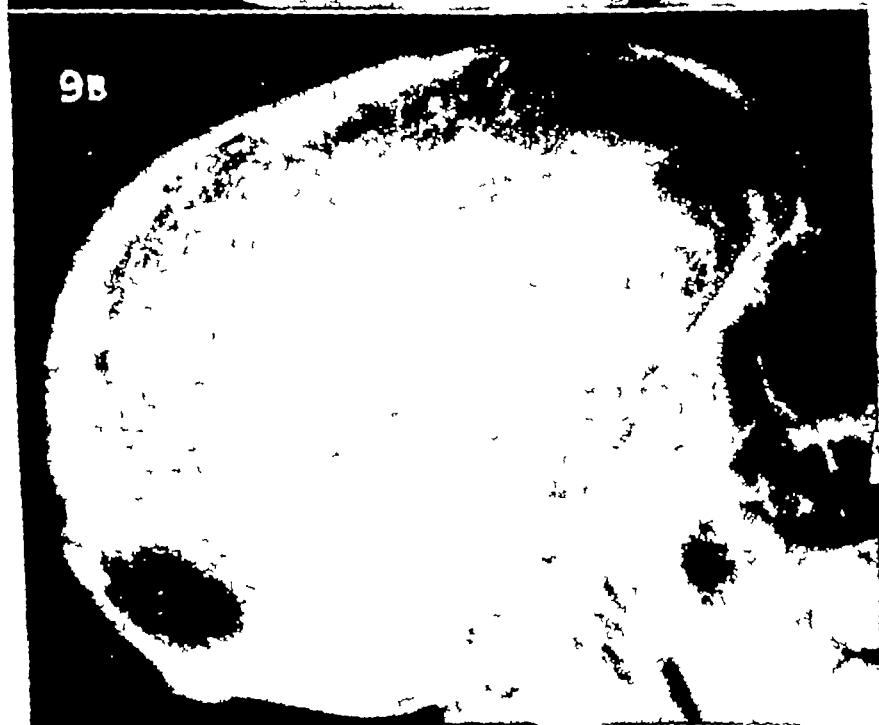
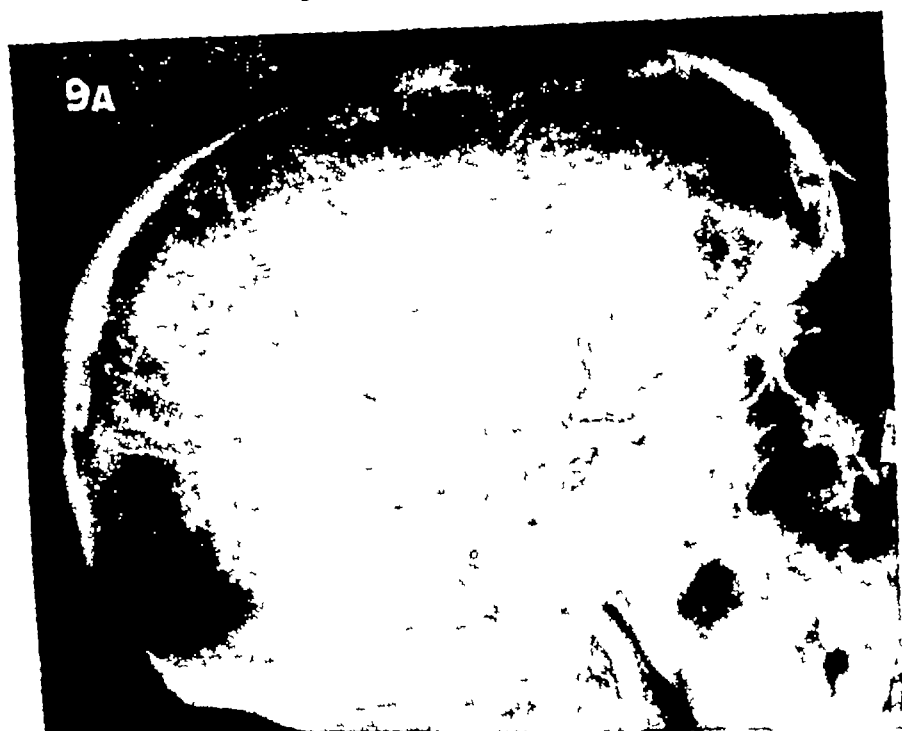


Fig 9 Comparison of arteriogram and venogram in a sarcomatous meningioma of the olfactory groove A Lateral arteriogram, showing typical displacement and faint capillary shadow B Lateral venogram, showing dense capillary shadow of entire tumor

slower than that of the brain, thus producing a local accumulation of contrast material. As Egas Moniz (5, 10) pointed out, in vascular meningiomas near the carotid siphon, *e g*, those of the lesser sphenoidal wing, the diffuse radiopacity may become visible during the arterial phase, *i e*, one to one and a half seconds after the beginning of the injection, meningiomas of other location usually show the capillary shadow a little later, *viz*, in the venous phase, three to five seconds after the injection. In one case of an exceptionally vascular meningioma, we observed an irregular pleuform pattern of small vessels during the arterial phase instead of a diffuse opacification (Fig 6, B). Such a picture is similar to the arteriograms of true angioma or vascular glioblastoma (see below).

GLIOBLASTOMA

(55 Cases)

Glioblastoma is an infiltrating neoplasm which may show a certain degree of demarcation. Some glioblastomas are relatively avascular and contain large areas of necrosis, others exhibit excessive vascularization by poorly formed or pathologic blood vessels. Considerable brain edema is a common feature. All these anatomic characteristics can be recognized in angiograms of glioblastoma.

Due to the infiltrating manner of growth, displacement of cerebral vessels tends to be more diffuse and less profound than is the case in meningiomas of comparable size. Associated edema of the brain is responsible in a large measure for marked vascular displacement. This may give the observer an exaggerated impression of the size of the neoplasm.

The peculiar vascular pattern within glioblastoma is virtually pathognomonic of this neoplasm. Unfortunately, this characteristic vascularity cannot be shown in all cases by angiographic methods. Lorenz (9) found 24 of 45 cases of glioblastoma with a special circulation (53 per cent). In Hemmingson's (7) material the incidence was at least 64 per cent, in our own ma-

terial the incidence is lower—40 per cent or 22 cases in 55.

For a better understanding of the angiographic findings, it is important to review the vascular structures as shown by histologic methods. Hardman (1) distinguished four different zones in glioblastoma (Fig 10, A). In the *first* zone containing brain tissue adjacent to the neoplasm, the normal vascular pattern is well preserved. The capillaries may be dilated and occasionally form complex loops. In the *second* zone, representing the actively growing, invasive edge of the tumor, the normal angioarchitecture is disrupted. Adjoining capillaries undergo "glomeruloid" changes, consisting of localized dilatations resembling aneurysms and tufts of endothelium which are directed toward the center of the tumor (Fig 10, B). In addition, one observes large sinusoid vessels which presumably have developed from dilated capillaries. In the *third* zone, comprising the deeper though viable parts of the tumor, the sinusoids become larger in size but fewer in number, they tend to undergo thrombosis by adventitial thickening and proliferation of the endothelium of the intima. The *fourth* (central) zone of the tumor contains areas of necrosis, cysts, and fibrous tissue. All blood vessels are thrombosed and hyalinized.

The observable angiographic changes occur in the viable periphery of the neoplasm (the second and third zones), which measures 3 to 30 mm in thickness. The characteristic vascular pattern is produced mainly by the sinusoids, perhaps also by the "micro-aneurysms." In contrast to meningioma, the blood vessels of glioblastoma are poorly formed and irregular, on angiograms they may appear blurred, usually they cannot be traced over long distances and contain contrast medium in a variable degree of concentration.

It has been stated that direct arteriovenous communications exist in glioblastomas because at operation the veins of these tumors may be sometimes seen to contain arterialized blood (Olivcrona, 7), and arteriograms may show simultaneous filling

11A



Fig 11 Arteriograms of glioblastomas with characteristic vascular pattern A Temporoparietal glioblastoma with aneurysmal dilatations of small vessels B Lateral arteriogram of occipital glioblastoma with characteristic vascular pattern (sinusoids)

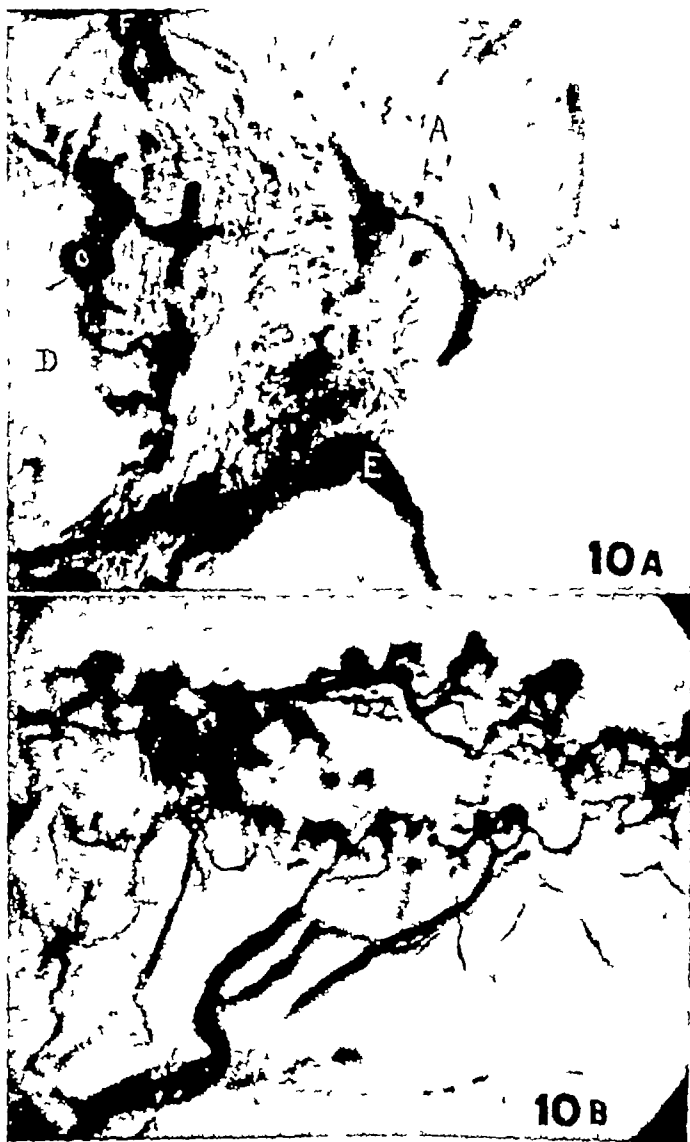


Fig 10 Illustrations from Hardman's article on the Angioarchitecture of the Gliomata. A Roentgenogram Section from a glioblastoma following vascular injection with barium paste. A Zone of normal brain surrounding the tumor. B Peripheral zone of tumor with irregular dilated capillaries and small sinusoids. C Deep zone of viable tumor with large sinusoids. D Necrotic avascular center of tumor. E Anterior cerebral artery. F One of the anterior cerebral veins.

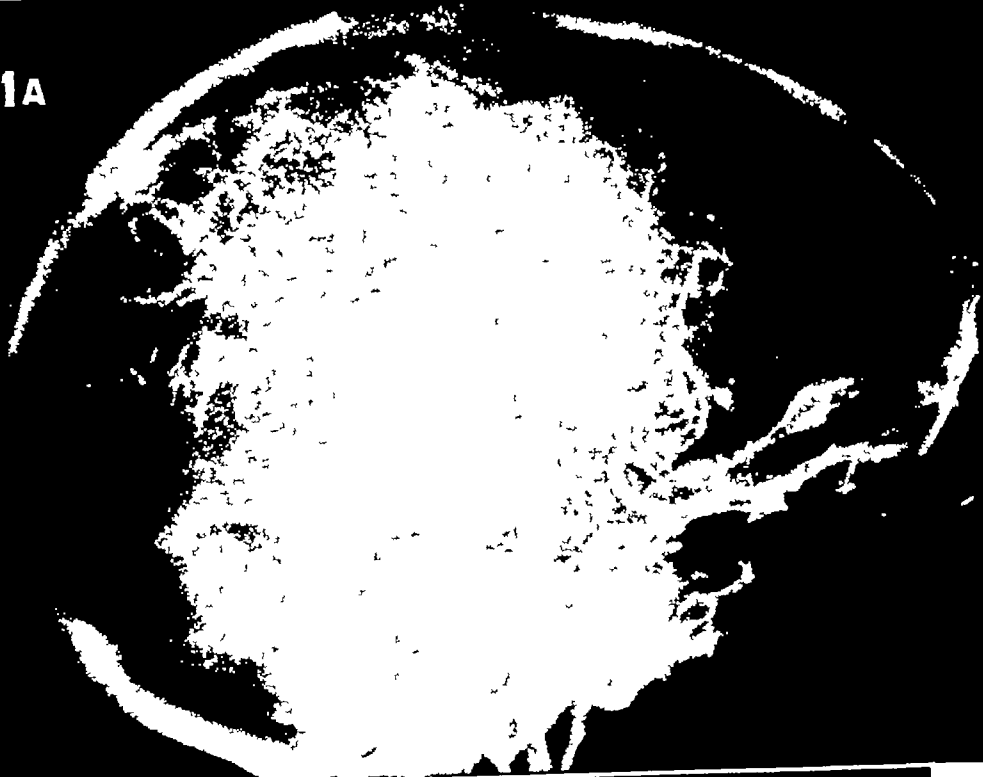
B Peripheral zone of a glioblastoma. Blood vessel stain. Aneurysm like dilatations of capillary loops and draining venules.

of arteries and veins or even apparent arteriovenous connections (Tonnies, 6). Hardman, however, found no real arteriovenous anastomoses in his anatomic studies, he explains the above clinical observations by the fact that the capillary bed is tre-

mendously dilated by the development of large sinusoids and that a considerable degree of short circuiting of blood probably occurs between pathologic vessels.

We have observed two types of special vascular pattern. In the *first* type, the

11A



11B



Fig 11 Arteriograms of glioblastomas with characteristic vascular pattern A. Temporoparietal glioblastoma with aneurysmal dilatations of small vessels B. Lateral arteriogram of occipital glioblastoma with characteristic vascular pattern (sinusoids)

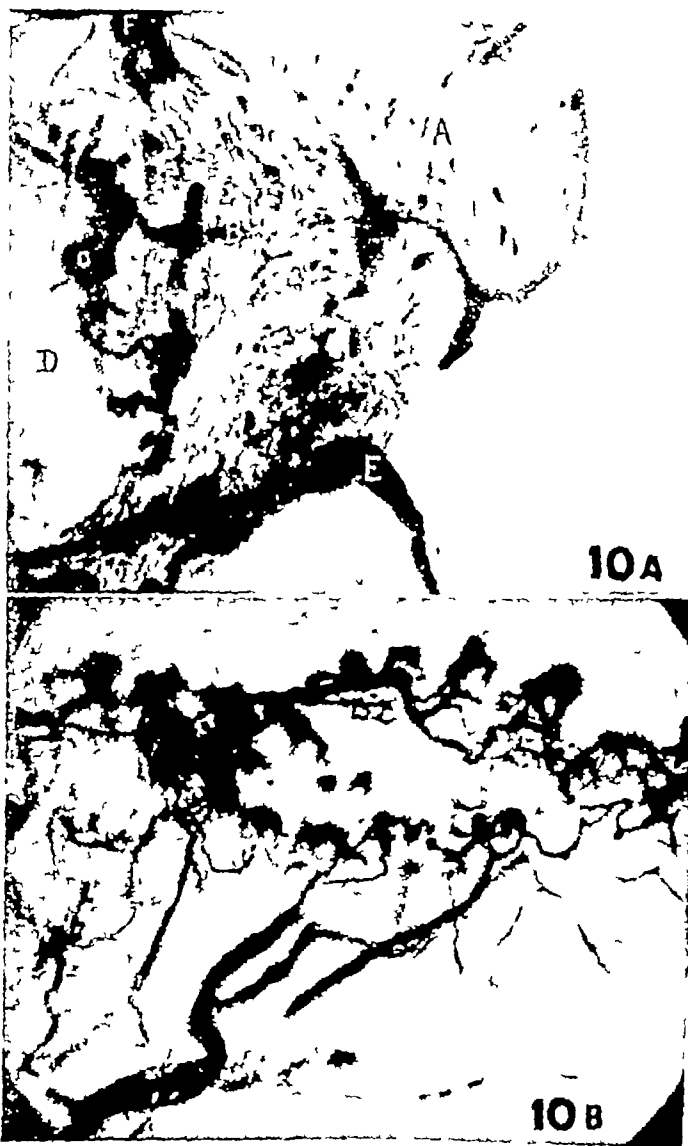


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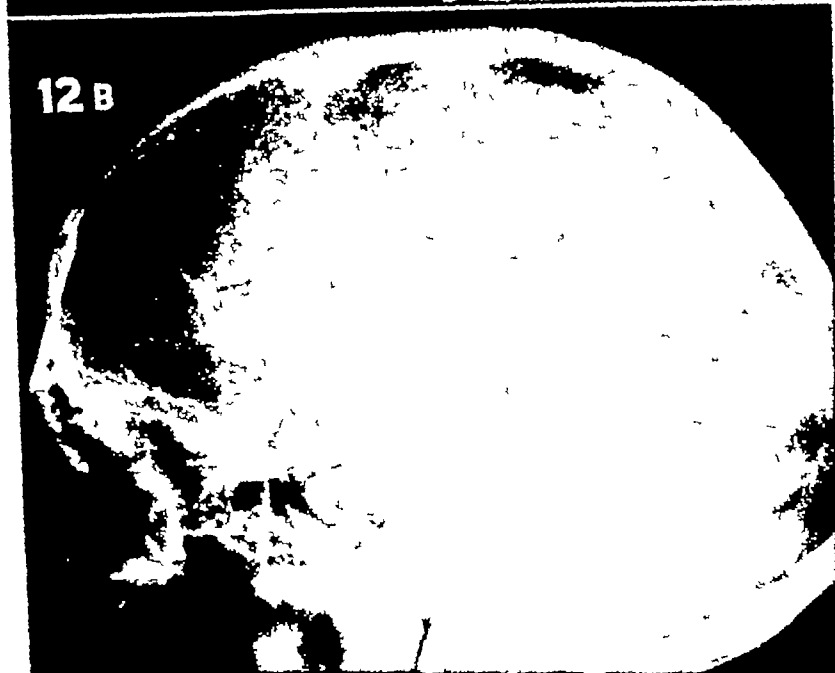
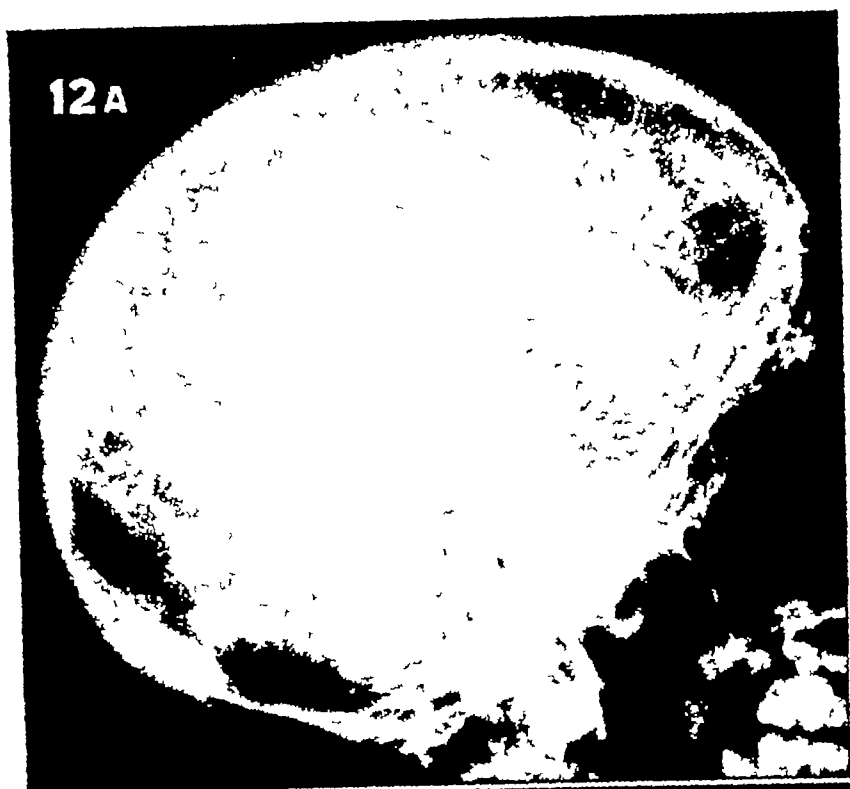


Fig 12 A Frontoparietal glioblastoma with very coarse vascular pattern. The rounded sharply demarcated appearance is due to a large cyst in the tumor. Note resemblance to vascular meningioma (Fig 6 B) B Lateral arteriogram of diffuse frontal and parietal astrocytoma. Note avascularity and diffuse stretching of arteries.

tumor exhibits an irregular network of fine crisscrossing vessels (Fig 11, A) In addition, there may be a few larger sinusoid vessels which tend to form lacunar dilatations and produce spiral or corkscrew patterns (Fig 11, A) The general vascular design may resemble the roentgenographic appearance of the normal lung, although it is more irregular and spotty (Fig 11, B) Uniform capillary opacity, as seen in meningioma, is never found in glioblastoma The *second* type of glioblastoma is characterized by a very coarse and bizarre vascular pattern which resembles that of an arteriovenous malformation (Fig 12, A) Large malformed vessels, frequently of larger caliber than normal cerebral vessels, can be traced through the tumor They may form spirals or arrange themselves in parallel layers (Egas Moniz, 2, 10) Some of these large vessels probably are huge sinusoids, others may be veins

In contrast to the true arteriovenous angiomatous malformations, well defined afferent arteries and efferent veins are not seen in vascular glioblastoma, furthermore, there is always displacement of adjacent normal vessels by the bulk of the tumor Since vascular glioblastoma has a necrotic or cystic center, its angiographic appearance (especially on stereoscopic films) is sometimes that of a sharply demarcated lesion covered by a peripheral plexus of vessels (Fig 12, A) Such tumors possess considerable similarity to certain vascular meningiomas (Fig 6, B), but scrutiny of the finer vascular texture will usually permit a differentiation As a rule, the best pictures of the vascular pattern of glioblastoma are obtained in the late phase of the arteriogram, one and a half to two seconds after beginning the injection, but occasionally the abnormal vessels are better visualized in the initial venous phase

ASTROCYTOMA (12 Cases)

Astrocytoma of the cerebral hemispheres frequently is an extensive growth diffusely infiltrating the white matter Judged from its gross appearance, parts of a hemi-

sphere or even an entire hemisphere may be diffusely enlarged and of increased consistency, sometimes without other significant macroscopic changes There is a tendency to interstitial liquefaction and formation of cysts The supply of blood is relatively scanty in astrocytoma and is not demonstrated too well by either angiographic or histologic methods According to Hardman (1), the capillary pattern in astrocytoma is not so grossly disrupted as in glioblastoma, the capillaries show increase in number, irregularity, and reduplication, without significant dilatation Correspondingly, the angiographic examination of astrocytoma reveals extensive stretching and spreading of the larger and medium-sized cerebral arteries The finer arterial branches, however, which are always visible on the normal arteriogram, may be entirely absent (Fig 12, B) It may be assumed that the neoplastic infiltration separates and distends the vessels and even prevents their filling with contrast material The frequent presence of cysts may be another factor to account for sparseness of blood vessels It is worthy of mention that the angiographic picture of brain edema resembles that of diffuse astrocytoma, but is far less marked in degree

We agree with Hemmingson (7) and Engeset (12) that a special (increased) circulation is decidedly uncommon in astrocytoma We observed in only two instances a fine brushwork of small vessels within the tumor (in one case in the arteriogram, in the other in the venogram) We disagree with Egas Moniz (10), who considered the presence of localized lacunar vascular dilatations a characteristic sign of astrocytoma Most authors (7, 12) believe that such changes are observed in mixed gliomas *i e*, astrocytoma verging to astroblastoma or glioblastoma, at any rate, they appear to indicate malignant propensities and are not germane to "benign" astrocytoma

OTHER TYPES OF INTRACRANIAL NEOPLASMS

Up to the present, our own experience with angiography in patients with brain

Familial Osseous Atrophy¹

GEORGE COOPER, JR., M.D., NORMAN ADAIR, M.D., and WILLIAM M. PATTERSON, M.D.
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THE OBJECT of this report is to introduce into the radiological literature familial osseous atrophy. The condition was first described by Smith (1), in 1934, its etiology is still unknown.

Our patient, a white male, age 25, was seen at the University Hospital on July 18, 1941, complaining of chronic ulcers on the plantar surfaces of both feet. Three years before, thick callus had appeared under the heads of the first and second left metatarsals, associated with moderately severe

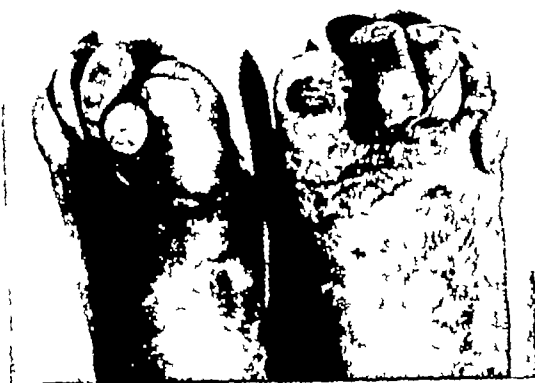


Fig 1 Chronic crusted ulcers which were present on both feet associated with localized hyperemia and swelling. Shortening of first digits, bilaterally, due to loss of bony substance.

aching pain following long periods of standing. Similar changes developed on the right foot shortly afterward. When the callus had been present several months, it blistered and sloughed, leaving large ulcers (Fig 1). These healed when the patient stayed off his feet, but recurred when he got up again. On several occasions, bits of bone were extruded from the ulcer craters.

On investigation of the family history, it was found that the patient's paternal grandfather had suffered from the same condition, beginning in his early twenties (see Family Tree). He had had recurrent

ulcers with sloughing of small pieces of bone until the feet were practically gone. He died in his sixties. The father is similarly affected (Fig 2) and, like the grandfather, has been reduced to crawling on hands and knees. At no time was any other portion of the body involved. Two uncles are affected (Fig 3), but the patient is the only grandchild suffering from the disease.

On examination of the patient, both feet were found to be cold and clammy. The distal two-thirds were moderately swollen, tender, and livid. There was a draining crusted ulcer under the interspace between

¹ From the Departments of Roentgenology and Surgery, University of Virginia Hospital, and Department of Medicine, University of Virginia. Accepted for publication in July 1946.

tumors has not been sufficiently large to describe a specific vascular pattern in certain of the rarer types of intracranial neoplasm. According to Hemmingson (7), Egas Moniz (10), and Engeset (12), oligodendrogliomas behave like astrocytomas and usually possess no special circulation. Metastatic carcinomas may show increased vascularity, resembling glioblastoma. In meningeal sarcoma, Lorenz (9) observed a rich double circulation from the internal and external carotid arteries and also arteriovenous anastomoses. Little is known about the angiographic appearance of ependymoma, pinealoma, and medulloblastoma.

Undoubtedly, preoperative knowledge of the vascularity of a lesion is very helpful to the neurosurgeon. It facilitates the plan of surgical attack in angiomas and meningiomas. With a definite diagnosis of glioblastoma established by angiography, surgery might not be undertaken at all in view of the hopeless prognosis.

SUMMARY

Cerebral angiography was performed in a series of 125 patients with verified intracranial tumor. In cases of angioma, meningioma, glioblastoma, and diffuse astrocytoma, the angiograms often are so characteristic as to permit a preoperative anatomic diagnosis.

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chronic inflammatory changes in the soft tissues and atrophy of the bone

Radiological examination at the time of the first admission revealed necrosis of the distal 4 cm of the right first metatarsal bone (Fig 6) The margin of the distal end of the remaining portion of the shaft was irregular, with multiple amorphous sequestra measuring from a few millimeters to a centimeter in diameter located about the first metatarsophalangeal joint There was no periosteal reaction The cortex was moderately decreased in density and the surface slightly irregular There was no loss of trabeculation except in the inferior distal centimeter, where the bone had an amorphous appearance There were similar changes in the proximal portions of the proximal phalanges of the first and second digits and in the distal centimeter of the fifth metatarsal The phalanges showed moderate atrophy and a decrease in circumference The soft-tissue shadows showed only the defect of the ulcer crater with slight thickening from edema There were similar changes in the left foot, involving the same bones but to a lesser degree

On the patient's readmission to the hospital, four years later, there was complete absence of the metatarsal bones except for the proximal portions (Figs 5 and 7) The remaining portions of the metatarsals were markedly atrophied The distal ends of the naviculars, cuboids, and cuneiforms

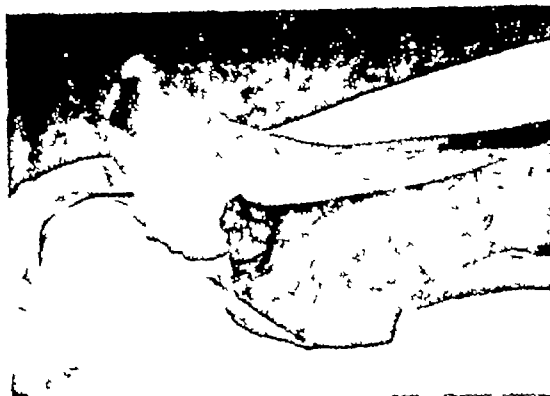
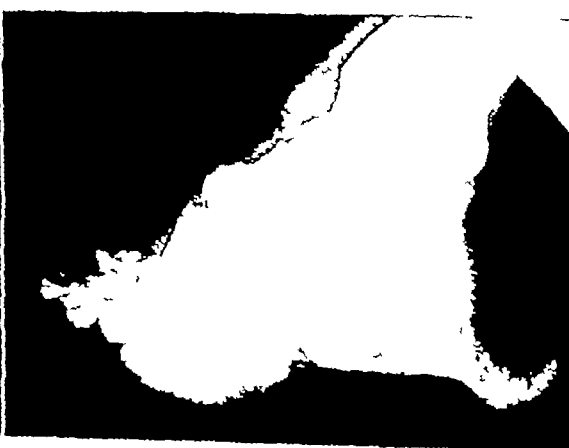
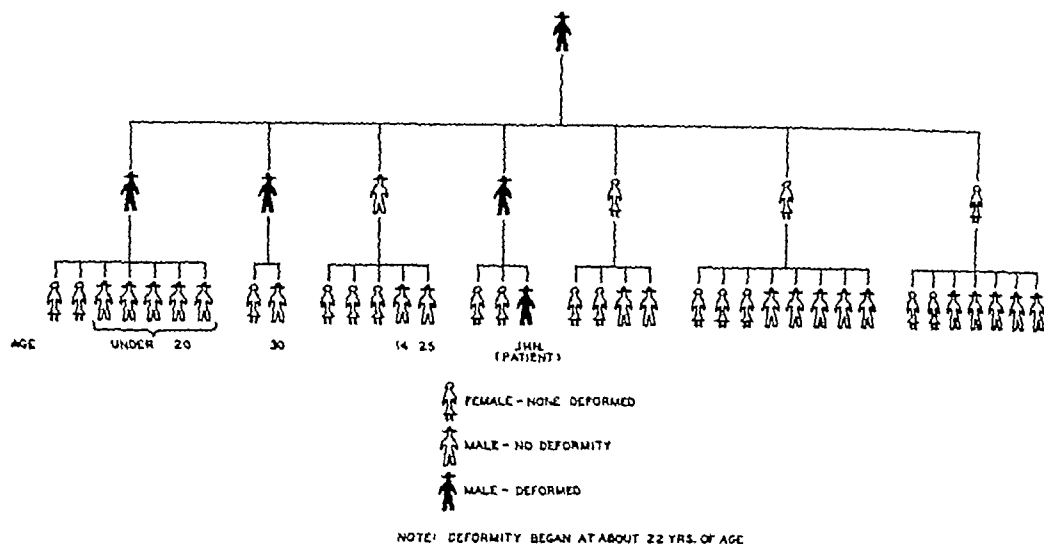


Fig 4 Photographs made four years after the patient was first seen (Fig 1) showing increase in size of ulcers and shortening of both feet

were absent The remaining bones were moderately atrophic On both occasions, the rest of the skeleton was normal in appearance

The radiological findings were not those



FAMILY TREE
JHN

the distal ends of the first and second metatarsal bones, bilaterally. Neurological examination revealed a loss of heat and cold sensation over the toes and hyperactive reflexes of the lower extremities. The pulsations of the dorsalis pedis and posterior tibial arteries were full and strong. There was a moderate bilateral inguinal lymphadenopathy. The remainder of the examination was essentially negative. The temperature, orally, was 99.2° and the pulse 88. An inguinal node was removed for biopsy and the report was "chronic lymphadenitis."

The patient signed out of the hospital against advice twenty days following admission, with the ulcers partially healed.

Four years later, Dec 10, 1945, he was readmitted for further study. In the interval he had had recurrent ulcers on the plantar surfaces of both feet, with moderate pain, swelling, and increasing difficulty in walking. The ulcers were larger and the feet were markedly shortened (Fig 4).

Tissue taken from the margins of the ulcers and a small piece of bone removed for biopsy were reported as showing

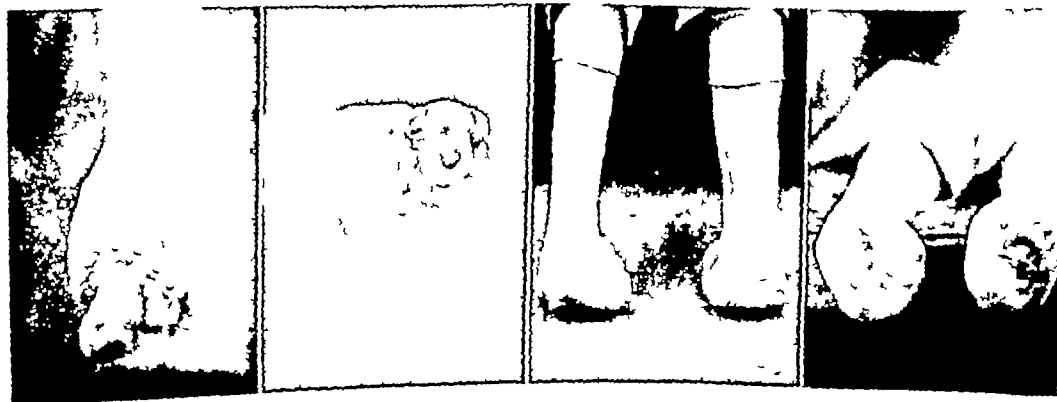


Fig 2 Left foot of patient's father

Fig 3 Feet of patient's uncle.

lar cases in 1939. In all, there was a definite history of familial tendency. In Tocantins and Reimann's group, several congenital defects were associated with the atrophy of the bones of the feet, which was not true in our case. In their group, also, both males and females were involved, while in the family considered here only males were affected. In all groups the onset was in early adulthood.

SUMMARY

Familial osseous atrophy, a disease of unknown etiology, follows a characteristic

clinical course and presents characteristic radiological findings. It is progressive after onset and terminates in crippling of the victim. No deaths have been known to occur from this malady.

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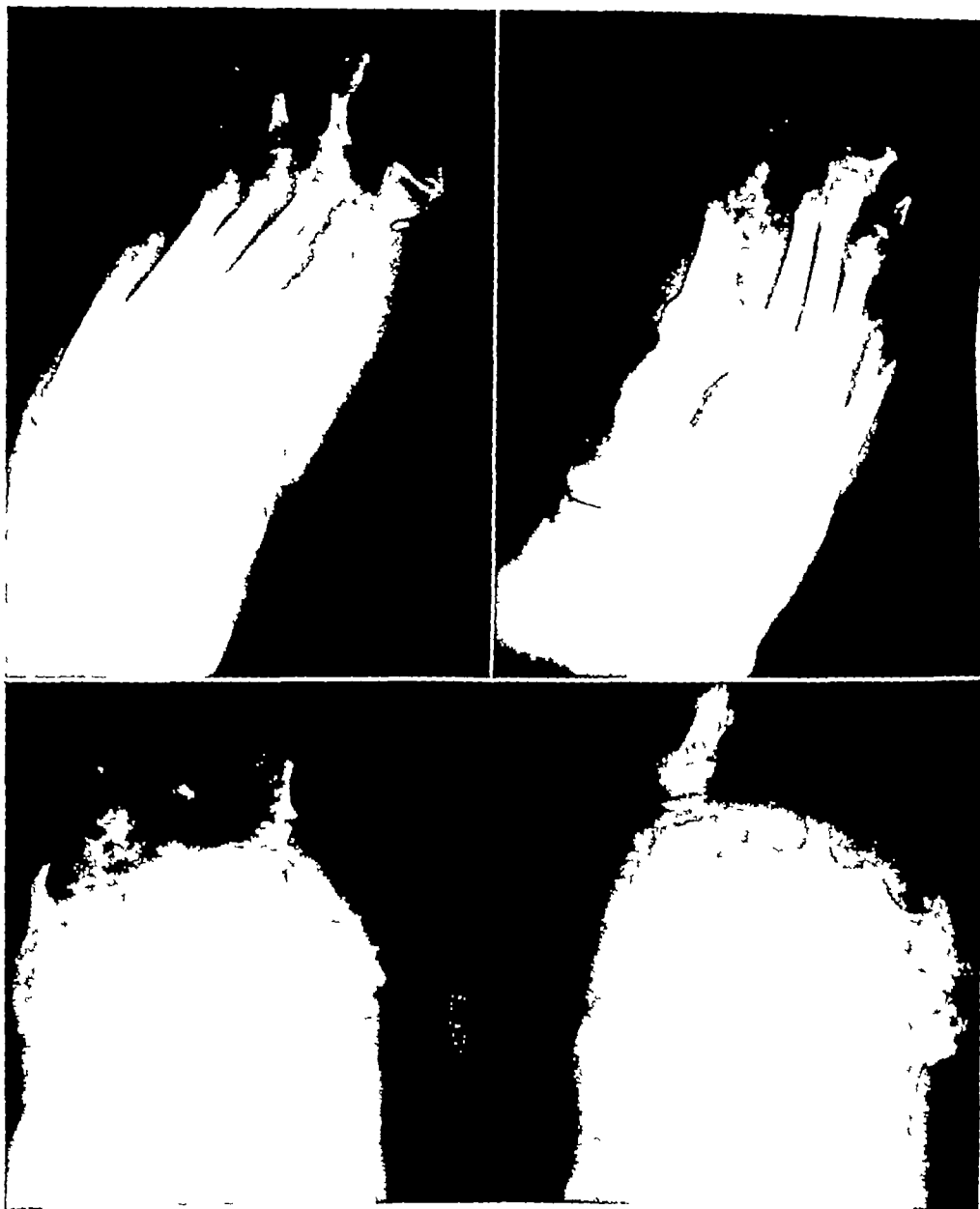


Fig 6 (upper views) Bone atrophy and dissolution present on first admission
 Fig 7 (lower views) Advancement of bone dissolution in four years

of pyogenic infection. Such infections as tuberculosis and fungus disease were ruled out by repeated smears and cultures. Specimens from an ulcer margin and from bone were also studied to rule out leprosy and infection. Serological examination of the blood and spinal fluid was negative for syphilis. The blood calcium was normal.

The only positive finding was a decrease in skin sensitivity to heat and cold which was localized to the distal portions of both feet. The pattern followed no definite outline of nervous innervation.

This case is similar in almost all respects to those reported by Smith (1) in 1934. Tocantins and Reimann (2) reported simi-

TABLE I EXHALATION OF RADON BY PATIENT HAVING RADON OINTMENT APPLIED TO A POST-PHLEBITIC ULCER OF THE MESIAL ASPECT OF THE LOWER THIRD OF THE LEFT LEG, COMPARED WITH TWO CONTROL SUBJECTS WITH SIMILAR APPLICATIONS TO THE LEFT LEG

Date Name Diagnosis	Amount Applied (49 Microcuries per Gram)	Area Applied (Approx)	Milli microcuries of Radon* per Liter of of Air After Various Intervals		Microcuries Exhaled during 4 1/2 Hours' Application	Percentage Exhaled in 4 1/2 Hours
10/9/45 J G Post-phlebitic leg ulcer	8.0 gm Oil silk adhesive dressing	25 sq cm	20 min 160 min 270 min	>3.0 11.5 4.59	>9.3	>2.4
10/9/45 E V Myxedema	8.0 gm Oil silk adhesive dressing	25 sq cm	20 min 160 min 270 min	0.508 0.393 0.205	0.50	0.13
10/9/45 G E Arteriosclerosis	8.0 gm Watch glass ad- hesive	25 sq cm	20 min 160 min 270 min	0.159 0.355 0.140	0.32	0.08
Room air near patient			20 min 160 min 270 min	0.017 0.0028 0.0015		

* All values corrected for decay from time of application of dressing

TABLE II EXHALATION OF RADON BY PATIENT J G, FROM TABLE I, FOLLOWED OVER A LONGER PERIOD, COMPARED WITH NORMAL CONTROL OINTMENT APPLIED TO CORRESPONDING AREAS

Date Name Diagnosis	Amount Applied (49 Microcuries per Gram)	Area Applied (Approx)	Milli-microcuries of Radon* per Liter of Air After Various Intervals		Microcuries Exhaled in First Four Hours	Microcuries Exhaled in 23 hours
11/20/45 J G Leg ulcer	7.4 gm Oil silk adhesive dressing	25 sq cm	11 min 30 min 1 hr 4 hr 8 hr 12 hr 20 hr 23 hr	10.4 16.6 10.1 7.1 24.0 13.3 4.1 3.3	6.7 (1.8%)	36.0 (10.0%)
11/20/45 F D Normal	6.3 gm Oil silk adhesive dressing	25 sq cm	11 min 30 min 1 hr 4 hr 8 hr 12 hr 20 hr 23 hr	2.5 1.0 1.3 3.7 6.8 5.7 1.5 5.0	1.2 (0.4%)	14.0 (4.5%)
11/20/45 Room air			11 min 30 min 12 hr 23 hr	0.0006 0.004 0.005 0.002		

* All values corrected for decay from time of application of dressing

leaked from the dressings. The experiments on these two patients, as shown in Table II, were carried out for 23 hours, with frequent sampling during the entire time of exposure. In one patient the ointment was applied to the intact skin, while in the other the application was made to a leg ulcer. This time the patient with the ointment on the intact skin exhaled during the first four hours approximately 1.2 microcuries or 0.4 per cent of the amount

applied, and during 23 hours 4.5 per cent. The patient with the leg ulcer exhaled during the first four hours approximately 6.7 microcuries or 1.8 per cent, of the amount applied, and during 23 hours 10 per cent. All calculations are based on the assumption that the subject exhaled 5 liters of air per minute. The content of radon in the room air during each experiment was found to be negligible (Tables I and II). It is seen that the radon con-

Absorption of Radon through the Skin and Its Exhalation through the Lungs¹

KURT LANGE, M.D.,² and ROBLEY D. EVANS, Ph.D.,³

THERE ARE numerous reports in the medical literature that the local application of ointments containing radon have therapeutic effects on deep-lying structures, such as joints, muscles, and blood vessels (1, 2, 3, 4). On the other hand, there is the well established physical fact that the alpha rays from radon and from its short-lived decay products, radium A and radium C¹, have a range, or penetration, of not more than 30 to 50 microns in tissue.

Because one of us (5) had observed lasting and deeply penetrating effects on the vascular structures of an area treated with ointments containing radon, it appeared interesting to follow the fate of the radon (a chemically inert gas) originally contained in the ointment, to determine to what extent it enters the tissues. If it could be shown that radon does enter the tissues, deep effects of radon ointment therapy would be understandable. Once present in the blood stream, this absorbed radon should be transported to the lungs, and a portion of it should then be exhaled in the expired air. Measurements of the radon concentration in samples of expired air, together with knowledge of the expiration rate, permit a direct evaluation of the minimum quantity of radon absorbed from ointment, and hence available for the alpha radiation of tissues at a distance of more than 50 microns from the site of application.⁴ The breath sampling and radon measurements were made by standard technics (6).

The experiments were carried out on normal intact skin, as well as on the surface of large post-phlebotic leg ulcers, which,

however, were very poorly vascularized as demonstrated by repeated fluorescence tests (7). The ointment in every instance contained 44.4 microcuries of radon per c.c. (49 microcuries per gm.) of lanolin. The thickness of the application varied between 2 and 3 mm. The areas were immediately covered with oil silk or a watch-glass and then sealed with several layers of adhesive.

In the first group of experiments, samples of the exhaled air were taken after 20 minutes, 2²/₃ hours, and 4¹/₂ hours. At each sampling time a specimen of the room air was taken and analyzed for its content of radon. In the first experiment, on three patients, possible inhalation of radon from the ointment during the procedure of application was largely inhibited by having the windows of the large ward wide open and creating a draft away from the patient's mouth toward the foot end of the bed. Table I indicates that approximately 2.4 per cent of the radon applied was exhaled within the first 4¹/₂ hours when the ointment was applied to the leg ulcer, while the amounts absorbed under the same circumstances from normal skin and exhaled were only 0.13 per cent and 0.08 per cent for the same period.

In the second experiment further precautions were taken to prevent inhalation of radon during the application of the dressings. During this period the patient breathed oxygen from a B.M.R. machine. Later a large fan constantly moved a stream of air from the head of each patient toward the foot end of the bed and a suction line was installed under the blanket to remove any radon which might have

¹ Accepted for publication in August 1946.

² New York Medical College Research Unit (Metropolitan Hospital).

³ The Radioactivity Center of the Department of Physics of the Massachusetts Institute of Technology.

⁴ The ointment used in these experiments was supplied by the Canadian Radium & Uranium Corporation, New York City (Dr. I. Tomarkin, Director of Clinical Research).

The Evolution of Radiology in Latin-America¹

JAMES T CASE, M D

Chicago, Ill.

A YEAR OR TWO AGO, on the occasion of a dinner meeting in Chicago in honor of some visiting colleagues from Latin-America, your speaker was impelled to discuss extemporaneously some of the important contributions of Latin-America to the advancement of radiology. When I was informed of the honor bestowed upon me by our Program Committee, I decided to enlarge upon this discussion by attempting to narrate the evolution of radiology in some of the countries of Latin-America.

My special interest in this subject has been stimulated by visits of numerous radiologists from Latin-America to my work in Battle Creek, Michigan, and in Chicago, and by my own visits to Cuba and to Mexico, as well as by two tours of the principal coastal national universities of South America. Further help has been afforded by correspondence and by a search of available literature.

ARGENTINA

When Roentgen's discovery was made known to the world, Dr Jaime R Costa, Professor of Medical Physics in the University of Buenos Aires, already established in his Sala de Fisioterapia in the Hospital Nacional de Clínicas, was able at once to utilize the new discovery, although the principal activity of the Institute concerned electrotherapy. Such progress was made in utilizing the x-rays that one of the early papers by Prof Costa, "La practica de los rayos X," published in *Anales del círculo médico Argentina* (23 1, 1900) concerned their use in fractures and dislocations, localization of foreign bodies, detection of hepatic and renal calculi, aneurysms, determination of the position and size of the heart, height of pleural effusions, extent of pulmonary tuberculous lesions,

size and mobility of the liver, and many other diagnostic uses.

Professor Costa's Sala de Fisioterapia later became the Instituto de Fisioterapia, and still later the present important Instituto de Radiología y Fisioterapia Alfredo Lanari, which is under the direction of the present Professor of Radiology, Dr Eduardo L Lanari.

A group of early workers in radiology included Alfredo Lanari, Humberto Carrelli, and Carlos Heuser. Dr Heuser in 1902 wrote an article entitled "Radiología" concerning which he said "I designate this work with the title 'Radiología' because I believe it to be more appropriate and more restricted to the different branches of this phase of science: radiocopy, radiography, endoscopy and radiotherapy." This was probably the first work published in the Argentine on radiology as a specialty. Heuser did notable work on the abdominal organs, kidneys, and pelvic organs, and between the years 1902 and the time of his death in 1934, he published a hundred or more articles on roentgen diagnosis and therapy and reported on various new methods of employing contrast materials for radiography. His diagnostic interests seemed to be focused on gynecological contrast studies. He made the first use of lipiodol in the genital apparatus in the year 1924. The writer read for Dr Heuser a paper on hysterosalpingography at the Third Pan-American Scientific Congress held in Lima in December 1924. Dr Heuser made several visits to the United States and Europe, enjoying a very wide acquaintance among the radiologists of the world. He was awarded the gold medal of the Radiological Society of North America in 1931.

Dr Alfredo Lanari was chief of Clinic for

¹ Read at the Second Inter-American Congress of Radiology, Havana, Cuba, Nov 17-22, 1948

centration in the inhaled air was only about one thousandth of the concentration in the exhaled air of either patient.

It is instructive to note that in the absence of diffusion of radon in the ointment, or actual absorption of the lanolin by the tissues, only a small portion of the radon applied could be effective in irradiating the tissues. This is because the average range of the alpha rays from radon and its radioactive decay products is about 40 microns of ointment. Over an area of 25 sq cm, a surface layer 40 microns thick has a volume of only 0.1 cc, or about one per cent of the volume of ointment applied. Alpha rays from disintegrating atoms of radon or its products situated more than about 40 microns from the lower surface of the ointment would be completely absorbed within the ointment, and could not emerge to irradiate the tissues. In Table II the radon actually exhaled greatly exceeded the radon content of a 40 micron layer of ointment. Evidently a much larger fraction of the total amount of radon applied becomes useful in irradiating the tissues beneath the ointment, by virtue of the continuous absorption of radon (and probably some lanolin also) from the ointment. In the 23-hour test on patient J. G. the radon exhaled was equal to that originally contained in a layer of ointment about 330 microns thick. Hence the efficiency of the ointment in supplying radon and its alpha radiation to underlying tissues is quite high.

It can thus be stated that appreciable amounts of radon applied in ointments are absorbed through the intact skin, and still more through open wounds. The radon exhaled must therefore have been carried to the patients's lungs internally, as in circulating blood or lymph. Radiation effects on deep structures may thus be produced if the amount absorbed and transported by the blood stream is sufficient. Whether amounts sufficient to produce tissue changes of therapeutic value can be thus absorbed and transported has not been proved.

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encephalography and on other problems relating to the skull, and has also made notable contributions in connection with military medicine in his country

One could mention a long list of other contributors to the progress of radiology in the Argentine. Among them should be specified Dr Alberto M. Marque, Director of the Institute of Radiology and Physiotherapy in the Hospital de Niños since 1907, when it was created and organized under his charge. He did early work on radiotherapy and possesses a brilliant collection of radiographs of osseous malformations, deviations, tumors, cysts, fractures, tuberculous osseous lesions, syphilitic lesions, etc., in an old and abundant material of radiographic plates, numbering some 15,000, which is considered one of the most valuable and varied radiological archives in South America. Dr José L. Molinari wrote much on the radiodiagnosis and treatment of diseases of the female pelvis and the breast. Many other distinguished men are on the program of this Congress. A listing of their contributions to roentgenology and roentgen therapy would constitute a veritable encyclopedia of radiology.

In Cordoba, Dr David Caro and assistants have done notable work. Here we also have Dr Mirizzi, who made special advances in the use of cholangiography in connection with surgery of the gallbladder. Dr Guido Politzer urged *diagrafia* for the registration of respiratory movements. Dr S. Di Rienzo is another indefatigable radiologist whose important work has contributed greatly to the advance of our specialty.

Dr Mario Vignoles of the University of the Litoral, Dr Antonio Padin and Dr Rodolfo Ivancich from the city of Rosario should be named in the roll of honor of Argentine radiologists.

Buenos Aires alone maintains three active cancer diagnostic and treatment centers. The Municipal Institute of Radiology is especially concerned with clinical and research problems in radiation therapy. The Cancer Institute is an impor-

tant one under the direction of Prof. Angel Roffo, whose name has become known throughout the medical world for his contributions to the etiology and biology of neoplasms. This Institute has a number of large buildings, including hospital facilities, radiological departments, and research laboratories. There is also an important tumor clinic in the surgical division of the University of Buenos Aires.

The original Radiological Society of Argentina was organized in 1917 and included such prominent radiologists as Alfredo Lanari, Antonio DeNucci, José F. Merlo Gómez and José A. Saralegui, Carlos Heuser, Carlos Niseggi, Santiago Torres Blanco, Otilio Destugue, Rafael Espindola, and Antonio Valdiesco. The Society was reorganized a few years ago and seems to be on a very substantial footing.

BRAZIL

In Brazil, as one of their leading radiologists has put it, the development of radiology has been dominated largely from outside the country. Early clinical radiologists were E. Xavier, A. Alvin, and Jorge Dodsworth. Xavier was Professor of Medical Physics at São Paulo, beginning his work in 1896. A. Alvin died as a result of irradiation injury.

In the second generation, Duque Estrada, Saint Pastous, Raphael de Barros, and Manoel de Abreu, all living, made their radiological débuts between 1910 and 1920. Their roles have been marvelous. Since that date the number has multiplied and radiology now exercises a decisive influence in the evolution of scientific medicine.

In 1912 a powerful x-ray equipment was established in the city of Pará by Magalhães and Silva Rosado. In 1916 at Belém, Até was well established in radiology. In 1917 Dr. Jayme Rosado, who had studied under Dr. Campelo and Dr. Duque Estrada, was becoming well known.

The use of x-rays in São Paulo began less than a year after the publication of Roentgen's discovery. In 1896 Professor

Professor Costa from 1902 to 1904, gave the first series of lectures on medical radiology in 1905, and following the death of Prof Costa in 1909 succeeded to the Chair of Physical Medicine. In 1918 he became the Vice Dean of the Faculty and in 1919 Dean of the Faculty of Medicine of Buenos Aires, which position he held until 1929, when he was named "Vocal of the Medical Council of Education." He was interested not only in radiology but performed an immensely efficient work in forwarding education in general. He died in 1930.

Dr Humberto Carelli is another of the group of radiological pioneers, having begun his career under Professor Costa in 1901 to 1904. Later, when Dr Alfredo Lanari became Professor of Medical Physics, Dr Carelli became Chief of Clinic during the years 1909, 1910 and 1911. Since then he has dedicated himself to the constant practice of radiology, in the course of which he has written on many themes, among which stand out his contribution to the radiological exploration of the abdomen by pneumoperitoneum and his personal contribution to the radiological exploration of the kidney by means of perirenal injection, known under the name of *neumoriñón* or perirenal emphysema, a method of examination which he described in lectures before universities, congresses, medical societies, and medical services of prominent personalities in foreign lands.

Dr Carelli has been an extraordinarily capable organizer, as is shown by his creation of the Municipal Institute of Radiology and Physiotherapy, which was planned by him and directed by him until the year 1937, at which time he retired from his laborious duties to his private professional practice.

Dr Eduardo Lanari in 1930 succeeded his brother, Prof Alfredo Lanari, as Titular Professor of Radiology and Physiotherapy in the Faculty of Medicine in Buenos Aires and Director of the Instituto Alfredo Lanari del Hospital de Clínicas. Dr Eduardo Lanari has written on the

exploration of the gallbladder, foreign bodies in the eye, diagnosis and treatment of vesical tumors and of thyrotoxicosis, and especially on kymography. His publications have been numerous.

Dr José A. Saralegui, after graduating in 1912, spent three years in the principal radiological institutes and centers of Europe. Thirty years ago he was named Chief of Service of Radiology in the Rawson Hospital and later in the Hospital Rivadavia, where he has earned on his radiological career. In 1937 at the International Congress in Chicago, Dr Saralegui received a medal for his work on cholangiography. From 1940 to 1943 he held the position of Director of the Municipal Institute of Radiology and Physiotherapy, Buenos Aires, where he developed a plan of organization and modernization of radiological activities, personally directing the section on cancer and tumors and their treatment by radiation. Dr Saralegui has contributed much to the study of the gallbladder by cholecystography and cholangiography, and to various phases of deep therapy in the treatment of tumors, including tumors of bone.

The late Dr José Gutiérrez was a prolific and serious worker connected with the Section of Radiotherapy in the Alfredo Lanari Institute in the School of Medicine of Buenos Aires.

The late Prof Martín Miranda Gallino was also possessed of a great enthusiasm for radiology. His numerous publications on the subject included a book on the heart. His premature death deprived radiology of a promising scientist.

Dr José P. Uslunghi is Professor of Radiology and Physiotherapy of the Faculty of Medicine of La Plata, Adjunct Professor of Radiology and Physiotherapy in the Faculty of Medicine of Buenos Aires, and connected with the Rawson Hospital.

Dr José F. Merlo Gómez, one of the most distinguished radiologists of Buenos Aires, is President of the Argentine Radiological Society and was President of the First Inter-American Congress of Radiology. He has done consistent work on

development of radiology of the vascular pedicle in the thorax. Among his former assistants was Dr Agunaldo Lins.

The National Department of Public Health of Brazil has a national cancer service in Rio de Janeiro, and there is in prospect a cancer institute. Other Brazilian cities have joined the cancer campaign, particularly Rio Grande do Sul, São Paulo, and Bahia. In Recife there is an Institute of Radiotherapy established in 1941 under the direction of Dr Waldemar Miranda. São Paulo is planning to open a cancer institute. Recife, São Paulo and Medellín all have radiological institutes.

CHILE

Zegers is credited with having introduced the x-rays into Chile in 1897. Another early radiographer was a Mr Eckwall, a Swedish graduate in gymnastics and massage, who worked as x-ray technician in the Hospital San Juan de Dios until he succumbed to numerous epitheliomatous lesions of the hands in the year 1915.

The first physician to incorporate x-rays in his diagnostic methods was the Professor of Physics in the School of Medicine, Dr José María Anrique, who had just returned from a study tour of Europe. Dr Anrique was chief of the service of radiology of the Hospital Clínico, and to him was due the organization of radiology in the different hospitals of the Beneficencia, which services he directed for many years until 1916. In that year he succeeded to the chair of Physical Medicine, and the direction of the radiological services was assumed by Dr José Ducci, a man of vast culture, whom members of the Chilean radiological group recognize as one of its most brilliant investigators. Ducci was a man of exceptional talent, improvising whatever apparatus he lacked. It seemed that there were for him no impossible problems. He developed stereoscopic fluoroscopy and serial radiography with apparatus of his own manufacture. Unfortunately a renal infection interrupted his magnificent work in radiological physics. The Institute of Radiology of the Faculty

of Medicine in the Hospital Clínico de San Vicente de Paul in Santiago was re-named in his honor, the José Ducci Institute of Radiology.

Ducci had the foresight to establish a sort of school of radiology where every day there were gathered together radiologists, pathologists and clinicians and their assistants for discussion of interesting clinical cases.

Among the radiologists who continued the work of Ducci were Drs Quevedo, Meza Oliva, and Adolfo Kaplan, who had assisted the chief of the laboratory for seven years. Kaplan has made several long study trips to the United States. A later group of radiologists included Drs Opazo, Daza, Gundelach, Dighero, Riedel, Viviani, Zárate, E Soza Gostling, L Guzmán, and many others. Dr Leonardo Guzmán is at present Director of the Institute of Radiology in Santiago, a most important clinical center and headquarters for the Chilean League Against Cancer.

COLOMBIA

An x-ray equipment was installed in Bogotá, Colombia, early in this century by Dr Isaac Rodríguez. Shortly afterwards Dr Germán Reyes also brought a diagnostic roentgen apparatus to Bogotá. At an early date Prof Julio Manrique set up x-ray equipment in Barranquilla. The late Dr José M Montoya has also been mentioned as an early user of Roentgen's discovery. It was not, however, until 1920 that radiology was seriously practised as a specialty in Colombia. At that time the Bogotá School of Medicine engaged the services of the French radiologist, Dr André J Richard, then working in the United States.

Very early there came about a tendency to divide the field of radiology into roentgen diagnosis and roentgen therapy. Dr Richard brought about the creation of a chair of roentgen diagnosis, which in 1934 provided for radiological instruction for last year medical students in the National University of Colombia.

Dr Alfonso Esguerra Gómez, who dis-

Ferreira Ramos of the Polytechnic School operated a small Crookes' tube with a Ruhmkorff coil, obtaining the first radiograph made in São Paulo. Early in 1897, Dr Alfredo Britto made a demonstration of x-rays in the Faculty of Medicine.

Medical radiology began in São Paulo with the work of Henrique Carlos Gruschke. In 1899, under the supervision of Prof Vieira de Carvalho, the first x-ray department was opened at the Santa Casa de Misericórdia. Studies were made at that time, not only of traumatic lesions of the skeleton but also of the cardiovascular and renal apparatus. The first roentgenogram of a twin pregnancy was obtained in 1906. Prof Vieira de Carvalho died of a grave anemia following a severe radio-dermatitis, after submitting to various amputations of the fingers, another Brazilian martyr to the x-rays. In 1906 methods of protection began to appear, including leaded aprons and lead glasses. Madame Gruschke followed her husband as director of the radiological services in the Santa Casa de Misericórdia, continuing also his teaching work.

Another outstanding medical radiologist in São Paulo was Prof Dr Edmundo Xavier. Other pioneers were W Seng, D Stapler, and A C Camargo. In 1913, coincident with the appearance of the first Coolidge tubes, there began to work in São Paulo Dr Raphael de Barros, Dr Priori, and Dr Nagib Scaff.

The advance of radiology in foreign lands was observed with interest by radiologists in São Paulo, and the various German, English, American, and French radiological publications all aided in keeping radiology in São Paulo up-to-date. The advent of serial radiography, stereoradiography, plamigraphy, and kymography, with various contrast materials, and the methods of Graham-Cole, Lichtenberg, and others, were all adopted promptly.

Today a large number of up-to-date radiologists are at work in this great city, and not only in radiography but also in radiotherapy. Most important progress has been made. Their publications and

communications before scientific societies have made them known. Particular mention should be made of the work of Cassio Villaca and Paulo de Toledo on the digestive apparatus, Eduardo Cotria on heart measurements, renal pathology, and gynecology, Cabelo Campos on hepato-vesicular pathology, and the work of Raphael de Barros on osseous pathology.

Radiotherapy began with the work of Lindenberg in 1911, who as a dermatologist took up superficial roentgen therapy. In the field of therapy other outstanding names are L Barretto and Roxo Nobre.

In the field of technic, the house of Lohner has constructed special apparatus for the measurement of the cardiac area by the method of Eduardo Cotria. Mention should be made, also, of the construction of apparatus for cineradiography, according to the method of José Jany and Dr Moretsohn de Castro and their associates.

A special method of cineradiography has been developed and publicized from São Paulo. Many efforts at roentgen cineradiography have been made. Prof H Rieder, of Munich, was one of the pioneers in Europe. In the United States Dr L G Cole in 1910 and later Dr Wm H Stewart, of New York, did notable work, though many others could be mentioned. Ing José Jany and his colleagues, notably Dr Moretsohn de Castro, devised a method of cineradiography utilizing a pre-hypersensitized film for photographically recording the fluoroscopic screen image. Jany contributed not only the idea and technic of hypersensitization but also the construction of accessory equipment which may be adapted to any radiological table by modifying the screen support. Jany's work is applicable not only to the chest and to the extremities but also to the gastro-intestinal tract.

The work of Manoel de Abreu in Rio de Janeiro deserves special mention. His pioneer work in photoroentgenography has led to the development of the present 4 by 5-inch technic perfected by Dr Hollis E Potter. Dr Abreu also did much in the

culosis, placing emphasis on fluoroscopic guidance in diagnosis and treatment

Filiberto Rivero was another active member of the executive committee of the original Cuban Radiological Society. He was a strong advocate of cooperation between the clinician, the surgeon, and the radiologist as a means of bringing to completion a joint work of the greatest benefit to the patient and to the study of human pathology. He contributed largely to the development of radiology as a specialty.

Francisco Cabrera Benitez published in 1913 a book on "Radiodiagnóstico y Fisioterapia de la Tuberculosis."

Other early leaders in Cuban radiology were Manuel Viamonte, whose best known contributions from 1927 to date include discussions of the radiological diagnosis and treatment of pulmonary abscesses, fibrinous pneumonia, cardiac insufficiency, lesions of the colon, including inflammatory and amebic tumors, and many other subjects. At the present time he is Professor of Radiology of the University of Havana and Director of the Department of Radiology in the Calixto García Hospital.

Dr Raúl Pereiras, in collaboration with Dr Castellanos and others, has made many important contributions to radio-paque angiocardiology, superior and inferior cavography, retrograde aortography, and anterior pneumomediastinum.

For original contributions of the greatest importance we are indebted to our honored colleague, Dr Pedro L Fariñas, who began his work in radiology in 1912. Special interest attaches to his intensive investigations and publications on serial selective bronchography. In these cases, instead of making roentgenograms after opacification of the bronchial tree, serial exposures are made during the most interesting and important phases of the filling of the bronchi. This permits the discovery of images, not otherwise visible, of very early lesions of bronchial cancer and other tumors, and especially of cases of incomplete bronchial stenosis. Dr Fariñas also recommends the replacement of iodized oils in bronchography by organic salt solu-

tions of iodine to avoid the inconvenience of lipiodol. Lately he has improved the technic by an original method of covering the mucosa of these organs with a very thin layer of opaque substance, accomplished by vaporizing an opaque medium in the vestibule of the larynx. Inhalation of this vapor causes production of very fine particles which are deposited along the mucosa of the larynx, trachea, and bronchi. Dr Fariñas has also contributed notably to retrograde abdominal aortography and phlebography.

ECUADOR

Pioneers in radiology in Ecuador were Dr Pablo Arturo Suarez and Dr Juan Verdesoto. These men were Professors of the Faculty of Medicine of Quito and of Guayaquil, respectively. Among the younger men who are at present active in radiology are Terán Gostalle, present Professor of Radiology in Quito, and Dr Julio Mata Martínez, Professor of Radiology in Guayaquil.

MEXICO

In 1899 some demonstrations of x-rays were made to the students of physics in the University of Mexico City. The first physicians to utilize x-rays in medical practice, as far as I can learn, were Dr Joffre (1900) and Dr Cícero, the latter being also an early advocate of x-rays in dermatology, recording the successful treatment of a case of ringworm of the scalp in 1911. The first pulmonary roentgenograms in Mexico were made by Dr Joffre in 1902, these studies being published by my friend Dr Alfonso Pruneda in an inaugural thesis concerning the symptoms and diagnosis of early pulmonary tuberculosis.

The Military Hospital was provided with x-ray apparatus as early as 1905. In that year Drs Zubieta and Pérez de la Vega and in 1910 Drs Peter and Somonte made various contributions on therapy and roentgen diagnosis. Dr Manuel F Madrazo, also one of this group of pioneers, is well known in the United States, through personal visits and by writings on various

covered the "pâte Colombia" or Colombian paste while working in the Radium Institute of Paris in 1922, was responsible for the creation in 1938 of the National Institute of Radium, devoted to radium and roentgen therapy. This Institute, connected with the Faculty of Medicine, up to 1944 has been equipped with six deep therapy installations and 25 grams of radium. The Institute is dedicated to research and education and maintains a course in cancerology for graduate students. The first director was Dr. José V. Hertas, who was recently replaced by Prof. Cesar A. Pantoja.

Roentgen diagnosis in Colombia owes much to our distinguished colleague, Dr. Gonzalo Esguerra Gómez, who has carried out extensive investigations and has written profusely on radiology of the gallbladder, on urography, the gastro-intestinal tract, and especially amebiasis. In well organized classes in the medical school, he and other members of the teaching personnel of the radiological staff have arranged and conducted roentgen instruction for undergraduate as well as postgraduate students.

Other Colombians whose works in the field of x-rays have come to our notice may be mentioned: Dr. Eduardo Ricaurte Medina, who made interesting observations on urography, certain bone lesions such as melorheostosis, secondary pulmonary tumors, pneumopericardium, and metastases from mammary cancer; Dr. Francisco Convers, who has engaged in both roentgen therapeutics and diagnosis; Dr. Carlos Trujillo Venegas and Dr. Jorge Rosas Cordovez, for their publications on diaphragmatic hernia and duodenal ulcerations; Dr. Julio Medina on aortography and arteriography; Dr. Omar Benavides on photofluororöntgenography; Dr. Emilio Acosta on leprosy in Colombia; Dr. Alejandro Isaza Botero on osteomyelitis in children of Bogotá; Dr. Milciades Mogollón Fernández on pelvimetry and anthropometry; Dr. Carlos Fajardo on the radiologic diagnosis of brain tumors. Of special interest in Colombia has been the subject

of rhinoscleroma, upon which Dr. Ricardo Calvo wrote nearly twenty-five years ago. Other publications were by Dr. Alfonso Esguerra Gómez and Dr. Daniel Brigard.

Another pioneer in medical radiology was Dr. Aguinaldo Soto, who, after practicing internal medicine for several years, took up the specialty of radiology in Paris, where he spent more than ten years. For several years he was Professor of Radiotherapy and Electrotherapy in the Faculty of Medicine of the University of Bogotá. Dr. Enrique Otero became well known as radiologist of the Hospital de San José de Bogotá and of the Hospital Militar.

The Colombian Radiological Society has recently been organized with twenty-two members, mostly from Bogotá, but with representatives, also, from Medellín, Cali, Barranquilla, and Armenia.

CUBA

In this the host republic of our Congress, the first physician seriously to dedicate himself to radiology was Dr. Alfredo Domínguez Roldán, first president of the Sociedad Cubana de Radiología y Fisioterapia. He is recognized by his colleagues as the "father" of radiology in Cuba and founder of several of the important radiological departments in the hospitals of Havana, where, under his supervision many of the now prominent Cuban radiologists began their work. He published a book on the thorax. In 1911 he was the official delegate from Cuba to the Second Congress of Radiología y Electrológica Médica in Barcelona, a report of which he made in a publication of two hundred and forty-six pages.

More or less contemporary with Domínguez were Dr. Emilio Alamilla and Dr. Carlos Desvernine. Alamilla did much to establish radiology as a specialty in Cuba. He was named Professor of Physics in the Instituto de la Habana in 1899, a position he held until his death in 1924 while on a visit to the United States. He was the first to establish deep therapy equipment in Cuba. Desvernine was especially devoted to the study of pulmonary tuber-

90° to the other. He has recently emphasized the value of cholecystography

URUGUAY

The first radiograph in Uruguay was made in the early months of 1897. There had been received in the customs house at Montevideo, addressed to the president of the republic, a box of suspicious character sent from Buenos Aires. At that time there functioned in Buenos Aires the directorate of the Nationalistic Party which had declared civil war against President Borda, who was later assassinated, on Aug 25, 1897. This box, which actually contained x-ray equipment, was immediately seized by the police, since there was a strong suspicion that it might be an infernal machine likely to explode on being opened. An expert from the department of physics of the University, Professor Scoseria, was instructed by the court to examine the box. Considering the form in which the box had been prepared for shipment, the exterior aspect indicating a very solid and careful construction, and considering, above all, that a paste with the odor of phosphorus had been found on raising one of the cleats covering the screws fixing the lid of the box, the fear was increased that it might be explosive. Professor Scoseria considered the matter sufficiently suspicious to justify an examination made with every possible precaution. It was a little more than a year and a half after Roentgen had published his discovery of the new kind of rays, that Girard and Bordet of the Municipal Laboratories of Paris had indicated the possibility of applying the roentgen rays to discover the presence of metallic substances in infernal machines. So, with the apparatus already existing in the Laboratory of Physics at the University, and with the assistance of Professor Willman, Professor Scoseria examined the box with the x-rays and determined the true nature of its contents. The full description and photographs of the apparatus, together with the means of examination, were published in *La Razón* of June 22, 1897.

Carlos Butler was the first Professor of

Radiology and Director of the Institute of Radiology in the Faculty of Medicine of Uruguay. In 1939 he was named also Director of the Institute of Radiology and of the Center for the Campaign Against Cancer carried on by the Ministry of Public Health. In 1943, Drs. García Capurro, Frangella, and Caubarrere were named as assistant professors.

In the following year Professor Butler retired from the direction of the Institute of Radiology and the Chair of the Faculty of Medicine, being succeeded by Dr. Pedro Barcía as Professor and Director of the Institute of Radiology, and Dr. Frangella in his turn was named sub-director of this same Institute. But Dr. Butler continued with the direction of the Institute and Center for the Campaign Against Cancer carried on by the Ministry of Public Health until Nov. 8, 1943, the date of his death. Dr. Félix Leborgne was named director in his place.

It should be noted that under the stimulus of Professor Butler and of Professor Barcía, radiology in Uruguay has reached a degree of advancement worthy of great commendation. Let us note briefly the fine work of Butler in the organization of the battle against malignant diseases and his publications on the subject, the numerous writings of Pedro Barcía on various themes, especially the digestive tube, a book on cancer of the larynx, the magnificent work of Félix Leborgne, the writings of Raúl Leborgne dealing with the breast, various books and articles of García Capurro on the thorax and abdomen, a book and articles by Frangella on therapy, contributions by Caubarrere, and various others. These Uruguayan contributions constitute an eloquent testimony and a bright promise of what may be expected in the future from the radiologists of that republic.

VENEZUELA

The earliest reference to x-rays in Venezuela appears to be an article by Dr. Elías Toro in 1897. About ten years later Dr. Luis Felipe Blanco described the value of

topics related to orthopedic roentgenology as well as on roentgen kymography Dr Celis has presented works on angiocardiology by catheterization of the jugular vein Recently Dr Carlos Gómez del Campo has explored the aorta by direct puncture of the arch, but this work is still experimental Dr Perez Cosío has written on cholecystography

Dr Larios and Dr Cornelio in Guanaquato were early workers in radiology, the latter dying in consequence of x-ray injuries

The campaign against cancer in Mexico has made excellent progress The General Hospital of Mexico City has a new Cancer Institute An annual cancer congress is held in Guadalajara Monterrey has an Institute of Radiology established in 1936

The Radiological Society in Mexico has recently been organized, some of the charter members being Dr Dionisio Pérez Cosío, Dr Guillermo Rodríguez Garza, Dr Manuel F Madrazo, Dr Carlos Coquí, Dr Jose Ramírez Ulloa, Dr J Arribas Aveleyra, Dr Juan José Quezada, Dr Carlos Gómez del Campo

PERU

The first x-ray apparatus was brought to Peru and the first radiograph was made by Dr Constantino T Carvallo, Professor of Gynecology in the Faculty of Medicine of Lima, who with European apparatus obtained a film of the hand one night in October 1896 According to Dr C E Paz Soldán, President of the Sociedad Peruana de Historia de la Medicina, that night there were obtained roentgenograms of the hand of the President of the Republic of Peru

The Hospital of Santa Ana for women was the first hospital to be provided with an x-ray installation, in about 1904, and there chiefly radioscopy was practised This department was directed by Dr I Avenañado and later by Dr E Olivares

A more complete x-ray equipment, with which regular roentgenographic work was done, functioned later in the Hospital Dos de Mayo for men, under the charge of

Dr J L Becerra, the dean of living radiologists in Peru, who is still director of that service In 1922 the out-dated German radiological installation in the Hospital Dos de Mayo was replaced by modern American equipment through the philanthropy of Mr A Aspillaga, who about three years later provided the new hospital for women, Arzobispo Loayza, with a complete roentgen diagnostic and roentgen therapeutic equipment, including apparatus for treatment at 200 kilovolts, directed by Dr Oscar Soto, with the collaboration of Dr S Sánchez Checa, Dr H Pesce, and Dr E González Vera

Official instruction in radiology in the Faculty of Medicine of Lima was carried on from 1923, the first professor being the late Dr Estéban Campodónico Since 1935 the professor of radiology has been Dr Oscar Soto

In 1938 the Peruvian Society of Radiology was organized Its presidents, from its foundation until today, have been the following radiologists Dr Oscar Soto, Dr S Sánchez Checa, and Dr E González Vera

Among the Peruvian hospitals provided with radiological installations should be especially mentioned the Hospital Obrero, with five apparatus for diagnosis and two for therapy, The Instituto Nacional de Radioterapia where there are four installations for radiotherapy to which two more are being added, the Hospital Arzobispo Loayza with three radiodiagnostic installations and two for therapy, and the Hospital Dos de Mayo with two equipments for diagnosis

A prominent Peruvian physician who started out in radiology but became so enamored of flying that he devoted himself to aviation is Dr Armando Revoredo, now a General in the Aviation Section of the Peruvian Army

Dr Fortunato Quesada has done much to advance radiology We are indebted to him for a simple but very effective technique for radiography of the clavicle, whereby two films are obtained in such a way as to record two projections, one at an angle of

EDITORIAL

Anatomical Variations in the Female Pelvis The Caldwell-Moloy Classification

Since 1933, when Caldwell and Moloy (1) first came out with their classification of the female pelvis, several articles have been written by the same authors and their co-workers on the general use of x-ray in the study of the mechanics of obstetrics, particularly as it relates to pelvic form and fetal-pelvic relationships. Other writers have added to the literature follow-up reports to evaluate further the application of these studies by careful clinical-roentgenologic correlation. It has been rather definitely shown that measurements are not the entire story and that the x-ray can be of aid in determining the course of labor over and above the procedures which deal primarily with the mensuration of the fetal head and maternal pelvis. The problem is not entirely one of size, but includes pelvic form and fetal-pelvic relationships. If one disregards the clinical correlation, particularly with border-line disproportions, one will easily mislead the clinician and discredit an otherwise valuable roentgen procedure, however important fetal cephalometry and maternal pelvimetry may seem to be in a specific case.

A recent article by Nicholson and Allen (2) we believe deserves some comment. These authors criticize the Caldwell-Moloy classification of the female pelvis because of its lack of precision. They feel that there are so many subclassifications under the four parent types that the method of classification becomes unwieldy. To quote these authors: "Classification may be a fine weapon in the armament of science, but classification without precise definition is simply the negation of science and can only lead to the multiplication of types until every example has a type of its own."

They seek to disprove (1) the fact that the android pelvis is a male pelvis and that it is associated with other male stigmata in the female, (2) that the android pelvis and to some extent the anthropoid pelvis are associated with narrow outlets, and (3) that the android pelvis is associated with difficult labor, propositions which they say Caldwell and Moloy have propounded. They attempt to produce proof that the android pelvis is associated with neither contraction of the pubic angle nor with difficult labor. They also point out that any deformities in the pelvis which lead to difficult labor are due to deficient nutrition in childhood.

Some of these ideas cannot go unchallenged. In the first place, Caldwell and Moloy never "argued" that the android pelvis was necessarily associated with difficult labor. They did say that a relatively small android pelvis is more apt to cause trouble than a relatively small gynecoid pelvis because of the difficult mechanism that may be associated with the android type. In those pelvises which are border-line or normal as to size, the pelvic form may play a major role. In this regard Nicholson and Allen have missed a very important point. They have apparently misunderstood the literature in regard to the Caldwell-Moloy classification and its clinical application. It is obvious that a large android pelvis does not necessarily mean difficult labor. Furthermore, a careful review of the writings of Caldwell and Moloy and their co-workers will disclose the fact that these authors are very emphatic in pointing out that the subpubic arch does not necessarily reflect the pelvic type. It may be more common to find a

the x-ray in determining the size of the stomach. Another ten years elapsed before there began to appear literature on roentgen diagnosis.

In 1917 Dr Rafael Gonzales Rincones and his brother, Dr Pedro González Rincones, began a series of contributions which over the course of many years have proved numerous, both in the field of x-ray diagnosis and therapy and in that of radium therapy. Their earlier contributions concerned the digestive tube, but they later reported on cholecystography, stereofluororadiography, and mass photofluorography, as well as excretion urography. All the advances of radiology which have been made were promptly taken up by the Drs González and adapted to their work in Venezuela. In addition, Dr Pedro González Rincones brought out a new technic for simultaneous radiographic exploration of the mastoids bilaterally.

Other contributors to the advance of roentgen diagnosis have been A J Castillo and P A Gutiérrez Alfaro, who have written on pyelography and roentgenography of the mastoid. Otto van Steis and A M Aguado wrote on the gallbladder. M Galland and H de las Casas wrote on lumbosacral diagnosis, A Puigvert on urography in 1930. Enrique Márquez Irigorri in 1931 described the first hysterosalpingography done in Venezuela, further described by E P de Bellard

in 1933. R L Araujo in 1934, Adolfo D'Empaire in 1934, and P A Gutiérrez Alfaro in 1941 all made further contributions. Manuel Noriega Trigo in 1936 and Carlos Ottolina in 1938 have written on ventriculography. Tomography was described in 1938 by Dr Pedro González Rincones, who in 1931 also reported on excretion urography. E P de Bellard in 1933, A Alvarenga in 1938, A Borjas in 1939, L E López in 1941 and finally Pedro González Rincones in 1944, all have studied and reported on excretion urography.

Roentgen therapy has been a favorite subject of radiologists in Venezuela, beginning with P Aguerrevere in 1907, E Ruis Viso in 1917, Rafael González Rincones, Dr Luciani, and Emilio Conde Flores in 1923, Victor M Lozada in 1931, and numerous others.

The Luis Razetti Cancer Institute has been in operation for a number of years.

The purpose of this communication has been to assure our colleagues of Latin America that we of the North feel a great interest in the radiological activities of our co-workers, and salute them for the great work which they have done. No doubt numerous omissions and some errors will have crept into this account, and for these forgiveness is asked.

55 E Washington St
Chicago 2, Ill



ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN COLLEGE OF RADIOLOGY EXPANDS PUBLIC RELATIONS PROGRAM

For some six years the Committee on Publicity of the Radiological Society of North America has availed itself of the assistance of the Commission on Public Relations of the American College of Radiology in publicizing the annual scientific sessions. A large amount of favorable publicity, educating the general public concerning radiology, has thus appeared in the nation's press.

A generous grant of funds from the X-Ray Section of the National Electrical Manufacturers Association to the American College of Radiology has enabled the Commission on Public Relations to expand its work this year. The press relations program is no longer confined to the annual meetings of the two scientific societies but is sustained throughout the year. The editors of *RADIOLOGY* and of the *American Journal of Roentgenology* send advance page proof of each issue to the College office, and from the papers appearing in these, one or more news stories are prepared and distributed to members of the National Association of Science Writers, wire services, state and county medical journals, and health publications.

This expanded activity of the College should be of real value in bringing about a better understanding of the specialty of radiology. Our thanks are due our good friends in the manufacturing industry who compose the X-Ray Section of the National Electrical Manufacturers Association for their generosity.

UNIVERSITY OF CALIFORNIA COURSE ON APPLICATION OF NUCLEAR PHYSICS TO BIOLOGICAL AND MEDICAL SCIENCES

The University of California Medical School, in association with University Extension, University of California, announces a Course in the Application of Nuclear Physics to the Biological and Medical Sciences. This course will be given at the Medical Center, in San Francisco, from June 30 through July 18, 1947. It will consist of didactic lectures, laboratory demonstrations, and seminars for round table discussions, and will be open to individuals in the fields of medical and biological research. Requests for detailed information are to be addressed to Stacy R. Mettler, M.D., Head of Postgraduate Instruction, Medical Extension, University of California Medical Center, San Francisco 22, Calif.

LOUISVILLE RADIOLOGICAL SOCIETY

The Louisville Radiological Society held its first post war meeting on March 20, 1947, at which time it was decided to hold future meetings on the second Friday of each month at the Louisville General

Hospital. Dr. Sydney E. Johnson was elected Chairman of the Society and Dr. Everett L. Pirkey, Secretary-Treasurer.

AMERICAN CONGRESS OF PHYSICAL MEDICINE

The American Congress of Physical Medicine will hold its twenty-fifth annual scientific and clinical session Sept. 2-6, inclusive, at the Hotel Radisson, Minneapolis. In addition to the scientific sessions, the annual instruction courses will be held Sept. 2-5. Requests for further information should be addressed to American Congress of Physical Medicine, 30 North Michigan Ave., Chicago 2, Ill.

In Memoriam

ROBERT E. DOWNING, M.D.

Dr. Robert E. Downing died on Oct. 5, 1946, at the age of forty-one. He was graduated from Emory University in 1930 and received his training in radiology at Long Island College Hospital. For several years he was in private practice in Terre Haute, Indiana, where in 1936 he married Miss Mildred Pinnell, a registered x-ray technician. He went to Lexington, Kentucky, as a radiologist at the Good Samaritan Hospital in 1938. Dr. Downing was a captain in the Medical Reserve Corps, and was called to active duty in July 1941, with an assignment at Bowman Field, Kentucky. He contracted an acute respiratory infection in August 1943, which was followed by cardiac complications. After long hospitalization, he returned to Lexington and part-time civilian practice at the Good Samaritan Hospital in 1944. He died following an attack of coronary thrombosis during a vacation at his father's home in Brewton, Alabama. He is survived by his wife and a four year-old daughter.

Dr. Downing was a diplomate of the American Board of Radiology and a member of the Radiological Society of North America. His professional skill and interest in the problems of his associates and their patients gained him the respect of all with whom he came in contact in his work. A friendly smile and a delightful sense of humor had won "Bob" the genuine affection of all who knew him. That his professional career should be so soon brought to a close is a source of deep regret.

D. B. HARDING, M.D.

JAMES MURRAY FLYNN, M.D.

James Murray Flynn died in St. Mary's Hospital, Rochester, N.Y., on Dec. 14, 1946, after a short illness. Dr. Flynn was born in Rochester March 29,

narrowed subpubic angle in an android type but this does not necessarily hold true

Nicholson and Allen further would like to eliminate any hereditary or hormonal factors as a cause for a pelvis which produces difficult labor. All pelvic deformities they attribute to deficient nutrition in childhood. It is difficult, indeed, to see how deficient nutrition would produce the long oval type of pelvis, namely the extreme anthropoid type. No one will deny that nutrition has an effect, but probably only in so far as it affects the general size of an already predetermined pelvic type. Whereas Caldwell and Moloy have wished to emphasize the shape rather than the size, their critics apparently wish to reverse this and go back to the old idea that size alone counts.

It is difficult to understand the complaint of Nicholson and Allen about the intricacy of classification. Their four types correspond to the four parent types of Caldwell and Moloy. If they wish to stick to these without using subtypes, I am sure Caldwell and Moloy would have no complaint. Any classification that attempts to be too complete may admittedly become unwieldy.

The deductions of Nicholson and Allen may, however, have the danger of discrediting an important contribution to our obstetric and roentgenologic knowledge and literature. We thus think caution is to be advised in interpreting their conclusions. There is little question that

Caldwell and Moloy have made a most valuable contribution by their classification. They have done much to help us apply roentgen-ray study to the female pelvis and have made it possible for the radiologist to aid his obstetrical confrere in a manner which has been of epoch-making significance. Before the detailed work of these authorities, the roentgen study of the female pelvis was a relatively uninteresting and certainly not easily applicable procedure. Caldwell and Moloy succeeded in popularizing the use of the x-ray in obstetrics and took it out of the mere field of mensuration. They have used a dynamic approach which has provoked many favorable comments from leaders in both the obstetric and radiologic fields. If Nicholson and Allen wish to stick to the four original types as described by Sir William Turner and use their pelvic index in talking about pelvic shape, that is their privilege, providing they obtain the same results as others. We still think, however, that Americans will be unafraid to use the Caldwell-Moloy classification even though our British confreres imply that it carries the threat of being too scientific.

PAUL C SWENSON, M D

REFERENCES

- 1 CALDWELL, W E AND MOLOY H C Anatomical Variations in the Female Pelvis and Their Effect in Labor with Suggested Classification. *Am J Obst & Gynec* 26: 479-505 October 1933
- 2 NICHOLSON C AND ALLEN H SANDEMAN Variations in the Female Pelvis. *Lancet* 2: 192 Aug 10 1946



Louisiana and Oklahoma. He had a ranch in Oklahoma, and next to his profession he enjoyed the country, for he was a natural fisherman and hunter. In fact, he loved life and made the most of every minute, living fully and abundantly. He was known for his honesty and integrity and had built an enviable reputation both as a radiologist and pathologist. He has left an example of good faith, good judgment, good teaching, and good fellowship. He reflected only credit and honor on the practice of medicine and of his specialty.

His wife, two sons, and a daughter survive him.

JULIA STEELE ELEY, M D

LOUIS M. PIATT, M D

Dr. Louis M. Piatt, of Columbus, Ohio, was killed March 2, 1947, in an automobile accident while returning from a vacation in Mexico.

Doctor Piatt was born in 1899. He was graduated from Ohio State University in 1923 and served his internship at St. Rita's Hospital, Lima, Ohio. Following this, he was engaged in general practice for sixteen years in Ottawa, Ohio. In 1940 he left Ottawa to become affiliated with the New York Post Graduate Medical School and Hospital. While there he served as resident radiologist for two years. In 1943 he became associated with Dr. Edward Reinert, of Columbus, Ohio, in the practice of radiology. He was also associated with Grant, St. Francis, and Mercy Hospitals. He was particularly interested in the treatment of cancer.

Doctor Piatt was a member of the Radiological Society of North America, the American College of Radiology, and the American Medical Association. Not only will he be missed by his professional associates, but his thoughtfulness and kindness will be long remembered by all who came in contact with him. He is survived by his wife, a daughter, a son, and by his brother, Dr. Arnold D. Piatt.

Book Reviews

X-RAY DIFFRACTION STUDIES IN BIOLOGY AND MEDICINE. By MONA SPIEGEL ADOLF, M D, Professor of Colloid Chemistry and Head of the Department of Colloid Chemistry, and GEORGE C. HENNY, M D, Professor of Medical Physics and Head of the Department of Physics, Temple University School of Medicine, Philadelphia. A volume of 215 pages with 86 illustrations. Published by Grune and Stratton, Inc., New York, 1947. Price \$5.50.

With courage in the face of several books by authorities on x-ray diffraction and with skill in the face of a difficult subject combining physics, chemistry, biology, and medicine, two distinguished scientists have brought together in this book widely scattered material of great usefulness particularly to research biologists. There has been an urgent need for such

a book, in a sense recognizing a new branch of biology and medicine. Here is first-hand evidence of the thinking and self-training and research of two medical school professors who have recognized, as pioneers, the value of diffraction technics in the study of materials produced by life processes. They have studied the literature intensively, envisioned their own research problems, designed and built on a limited budget their own apparatus, interpreted their own diffraction patterns to the best of their ability, and correlated the results with the findings from other clinical, chemical, and instrumental methods.

In order, the chapters present the theory of x-ray diffraction, apparatus and technics, interpretation, and studies on carbohydrates, amino acids and derivatives, proteins, nucleic acids and nucleoproteins, muscle lipids, nerves, steroids, and bones, teeth and concretions. The theory, apparatus and technics, and interpretations are presented as simply and briefly as possible. There is an air of quiet unpretentiousness about these chapters which seem to reflect the honesty of the authors in that they are not trying to compete with writers whose life-long specialization has been x-ray diffraction. Actually there is enough of the fundamental description of the tool and its use to permit adequate understanding of the results in chapters in which the authors stand on more familiar ground. There is throughout a kind of faith and undercurrent of enthusiasm for the x-ray field which strike a most sympathetic note within the reviewer in contemplation of his own quarter century of missionary zeal. There is also an unusually thorough and appreciative treatment of prior work in the attempt to give credit to everyone to whom it may be justly due, and akin to this is the modest appraisal of the valuable contributions of these authors themselves. One can forgive many shortcomings when a book is written in this spirit.

One might wish to find something about what space groups are (a few are given for specific cases in the old instead of the beautifully logical new international symbols), or reciprocal lattices, a concept so valuable for fiber and rotation patterns, and mentioned a time or two, or commercially available equipment, along with the details of a successful homemade unit, or a mention of the A.S.T.M. card index of powder patterns, which have superseded and gone far beyond the original Hanawalt-Dow tables. Of course, these things can all be found in more extended treatises, to which anyone undertaking research by this method would be expected to refer.

Well might these authors have undertaken to do this service with some fear and trembling at first, courage, devotion, and the true research spirit have seen them through successfully. The volume is worthy of a place in the reading of all scientists who have even a remote interest in the possibilities and the achievements of a branch of roentgen science entirely different from the more familiar diagnostic and therapeutic applications.



James Murray Flynn, M D

1882 He was graduated from the University of Buffalo Medical School in 1914 and did postgraduate work at Leland Stanford University Almost all of his medical work was as a specialist in radiology He served in France with Base Hospital 19 during World War I and received the rank of Captain At the time of his death he was roentgenologist for St Mary's Hospital and Park Avenue Hospital in Rochester

Dr Flynn had been president of the Medical Society of the County of Monroe, the Rochester Academy of Medicine, and Rochester Pathological Society He was president of the Medical Society of the State of New York in 1940 He was a fellow of the American College of Physicians, a fellow of the American College of Radiology, a diplomate of the American Board of Radiology and a member of the Radiological Society of North America, of the American Roentgen Ray Society, and the American Radium Society He belonged also to the Royal Faculty of Radiologists of England

As noted in the Bulletin of the Medical Society of the County of Monroe "In his passing, organized medicine loses a staunch worker, loyal friend and distinguished leader He was a stalwart champion of the rights of the medical profession, jealous of its honor and exemplified its duties and responsibilities in his own daily conduct" It could be said of him in the truest sense "I have fought a good fight I have kept the faith He will be greatly missed by his friends and associates

Dr Flynn is survived by his wife, a son, and four daughters

JOSEPH H GREEN, M D

LEONARD ALBERT MYERS, M D

On Nov 29, 1946, death from coronary occlusion came to Dr Leonard Albert Myers of Houston, Texas, director of the X ray Department of Memorial Hospital for the past sixteen years, and until six years ago also head of the pathology laboratory of that institution

Doctor Myers was born in Cloud County, Kansas, in 1896 His boyhood was spent in Oklahoma and he was graduated from the University of Oklahoma Medical School in 1922 He served his internship



Leonard Albert Myers, M D

at Memorial Hospital, Houston, Texas, and later went to Alexandria Louisiana, where he was director of radiology and pathology for the Baptist Hospital of that city, serving at the same time as consultant radiologist and pathologist at the United States Veteran's Hospital No 27 He returned to Houston in 1930

Doctor Myers did postgraduate work at various northern and eastern clinics among which were Barnes Hospital of St Louis and the Mayo Clinic. He served in the Naval Reserve for seven years He was a member of the American Medical Association, Texas State Medical Society, Southern Medical Association, Radiological Society of North America, and the Texas Radiological Society During his stay at Memorial Hospital he was president of the Hospital Staff in 1942, and served on many important committees

Dr Myers had an unusually wide circle of friends in Houston and surrounding cities as well as in

RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates Address Howard P. Doub, M D, The Henry Ford Hospital Detroit 2, Mich

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary-Treasurer*, Donald S Childs, M D, 607 Medical Arts Bldg, Syracuse 2, N Y

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F Hare, M D, 605 Commonwealth Ave, Boston 15, Mass

AMERICAN ROENTGEN RAY SOCIETY *Secretary*, Harold Dabney Kerr, M D, Iowa City, Iowa

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F Cahal 20 N Wacker Dr, Chicago 6, Ill

SECTION ON RADIOLOGY, A M A *Secretary*, U V Portmann, M D, Cleveland Clinic Cleveland 8, Ohio

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John Day Peake, M D, Mobile Infirmary, Mobile
Next meeting at the time and place of the Alabama State Medical Association meeting

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary*, Fred Hames, M D, Pine Bluff Meets every three months and annually at meeting of State Medical Society

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary*, D R MacColl M D, 2007 Wilshire Blvd, Los Angeles 5

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION *Secretary*, Morris Horwitz, M D 2009 Wilshire Blvd, Los Angeles 5 Meets second Wednesday of each month at County Society Bldg

PACIFIC ROENTGEN SOCIETY *Secretary*, L Henry Garland, M D, 450 Sutter St, San Francisco 8. Meets annually with State Medical Association

SAN DIEGO ROENTGEN SOCIETY *Secretary*, R F Niehaus M D, 1831 Fourth Ave, San Diego Meets first Wednesday of each month

X RAY STUDY CLUB OF SAN FRANCISCO *Secretary* Ivan J Miller M D 2000 Van Ness Ave Meets monthly on the third Thursday at 7 45 P M, January to June at Lane Hall Stanford University Hospital and July to December at Toland Hall, University of California Hospital

Colorado

DENVER RADIOLOGICAL CLUB *Secretary* Washington C Huyler M D Mercy Hospital 1619 Milwaukee Denver 6 Meets third Friday of each month, at the Colorado School of Medicine and Hospitals

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary*, Robert M Lowman, M D, Grace-New Haven Hospital, Grace Unit, New Haven Meetings bimonthly, second Thursday

Florida

FLORIDA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maxey Dell, Jr, M D, 333 West Main St, S Gainesville

Georgia

GEORGIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James J Clark, M D, 478 Peachtree St, N E, Atlanta 3 Meets in November and at the annual meeting of State Medical Association

Illinois

CHICAGO ROENTGEN SOCIETY *Secretary*, T J Wachowski, M D, 310 Ellis Ave Wheaton Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8 00 P M

ILLINOIS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, William DeHollander, M D, St Johns' Hospital, Springfield Meetings quarterly as announced

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY *Secretary*, Frank S Hussey M D, 250 East Superior St, Chicago 11

Indiana

INDIANA ROENTGEN SOCIETY *Secretary-Treasurer*, J A Campbell, M D, Indiana University Hospitals, Indianapolis 7 Annual meeting in May.

Iowa

IOWA X RAY CLUB *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney E Johnson, M D, 101 W Chestnut St, Louisville

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary Treasurer*, Everett L Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R Anderson, M D, No Louisiana Sanitarium, Shreveport Meets with State Medical Society

The book is well printed on glossy paper and attractively bound. The x-ray patterns, many of which are most difficult to reproduce, show the care and high standards of the authors. Of the whole work, we may say "Well done!" Stimulation of research on the architecture of living materials is an inevitable consequence of this book.

APPLIED ANATOMY OF THE HEAD AND NECK FOR STUDENTS AND PRACTITIONERS OF DENTISTRY
HARRY H. SHAPIRO, D.M.D., Assistant Professor of Anatomy, College of Physicians and Surgeons, Columbia University. A volume of 303 pages, with 221 illustrations. Published by J. B. Lippincott Co., Philadelphia, 2nd edition, 1947.

This small but well written, well illustrated book of 290 pages is designed specifically for students and practitioners of dentistry. As such, it not only takes up the anatomy of the head and neck, but also correlates the anatomy of these regions with many clinical problems. In this respect the book is unique.

The chapter on the temporomandibular joint is particularly impressive, since it very successfully relates the basic anatomy of this area to the complex clinical problems that arise therefrom. From a radiological standpoint, however, the book does not appear to offer anything beyond what has previously been published in basic texts on this subject.

HARVEY CUSHING: A BIOGRAPHY By JOHN F. FULTON. A volume of 754 pages with numerous illustrations. Published by Charles C. Thomas, Springfield, Illinois, 1946. Price \$5.00.

Foreseeing the demand for some account of his life and achievements, Harvey Cushing made provision in his will for the publication of a biography, should his wife and literary executor feel that this "might be of interest or help to medical students." Fortunately not only for the students whom Cushing had in mind but for all who are interested in medicine—and indeed many others—there was no question as to the desirability of such an undertaking. The result is this volume recounting the life of one of the foremost trail blazers and men of letters who have graced the medical profession during the past century.

Harvey Cushing was a product of the mid west, with a long line of medical progenitors of whom he was justly proud. He was educated at Yale and at Harvard, and then went to Johns Hopkins, where he was associated with Halsted and almost immediately fell under the spell of Osler and Welch, who profoundly influenced his life. One can trace Cushing's development in the field of letters from the time he became one of the "latch keyers" of the Osler household, culminating in his celebrated biography of Osler, for which he was awarded the Pulitzer prize in 1926.

After a thorough training in general surgery, Cushing devoted himself especially to surgery of the central nervous system and by intensive study and meticulous attention to detail achieved the position which made him world famous. He was largely instrumental in establishing neurosurgery as an independent specialty and trained an ever increasing number of men who have added further to his prestige. Roentgenologists will be interested to know that he set up the first x-ray unit in the Johns Hopkins Hospital and was always deeply interested in x-ray diagnosis and therapy.

Cushing's fullest development came after his appointment as Surgeon in Chief to the Peter Bent Brigham Hospital and as Moseley Professor of Surgery at Harvard University, where he spent twenty fruitful years. His last years were passed at Yale, and to that University his rich collection of medical historical books was bequeathed.

Dr. John F. Fulton, Sterling Professor of Physiology at Yale and Dr. Cushing's literary executor, has performed a notable task in the preparation of this biography, making effective use of the voluminous source materials available to him—diaries, letters, case histories, and other papers, which had been carefully preserved over the years. Abundant quotations from these personal records, enlivened with reproductions of Cushing's own inimitable sketches and with a large number of informal portraits of the surgeon and his professional contemporaries both in America and Europe, give the work almost the character of an autobiography. Mr. Charles C. Thomas, who was Cushing's own publisher, has done his part in making this work a fitting memorial to his friend. To all who are interested in medical history in the making and in biography at its best, the book will prove richly rewarding.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary*
Treasurer James M Converse, M D, 416 Pine
St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*,
Calvin L Stewart M D, Jefferson Hospital
Philadelphia 7 Meets first Thursday of each
month at 8 00 P M, from October to May in
Thomson Hall College of Physicians 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary Treasurer*,
Lester M J Freedman M D, 415 Highland Bldg
Pittsburgh 6 Meets second Wednesday of each
month at 6 30 P M October to May, inclusive

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-
Treasurer*, A M Popma, M D, 220 N First St
Boise, Idaho

South Carolina

SOUTH CAROLINA X RAY SOCIETY *Secretary-Treasurer*
Robert B Taft, M D, 103 Rutledge Ave, Charles-
ton 16

Tennessee

MEMPHIS ROENTGEN CLUB Meetings second Tuesday
of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer*,
J Marsh Frère, M D, 707 Walnut St, Chat-
tanooga Meets annually with State Medical
Society in April

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Sec-
retary*, X R Hyde, M D, Medical Arts Bldg,
Fort Worth 2 Meetings on third Monday of each
month, in Dallas in the odd months and in Fort
Worth in the even months

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer*,
R P O'Bannon, M D 650 Fifth Ave, Fort Worth
4

Utah

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*,
M Lowry Allen, M D, Judge Bldg, Salt
Lake City 1 Meets third Wednesday, January
March, May September, November

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE
Secretary, Henry H Lerner, M D Meets first and
third Thursdays, September to June, inclusive,
at Salt Lake County General Hospital

Virginia

VIRGINIA RADIOLOGICAL SOCIETY *Secretary*, E Latan
Flanagan, M D, 215 Medical Arts Bldg, Rich-
mond 19

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secre-
tary Treasurer* Frederic E Templeton, M D, 324
Cobb Bldg, Seattle 1 Meetings fourth Monday,
October through May, at College Club, Seattle

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-
Treasurer*, C A H Fortier, M D, 231 W Wiscon-
sin Ave Milwaukee 3 Meets monthly on second
Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MED-
ICAL SOCIETY *Secretary*, S R Beatty, M D, 185
Hazel St, Oshkosh Two-day meeting in May
and one day at annual meeting of State Medical
Society in September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Meets first and third Thursdays 4 to 5 P M, Sep-
tember to May, inclusive, Room 301, Service Mem-
orial Institute 426 N Charter St, Madison 6

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary
Secretary-Treasurer*, E M Crawford, M D, 2100
Marlowe Ave, Montreal 28, Quebec Meetings
in January and June.

LA SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE
ET DE RADIOLOGIE MÉDICALES. *General Secretary*,
Origène Dufresne, M D, Institut du Radium,
Montreal Meets on third Saturday of each
month

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
Offices in Hospital Mercedes, Havana Meets
monthly

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA
General Secretary Dr Dionisio Pérez Cosío,
Marsella 11 México, D F Meetings first Monday
of each month



ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V Schlosser, M D, Charity Hospital of Louisiana New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday, 7 30 P.M

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, Charles N Davidson, M D, 101 West Read St, Baltimore 1

Michigan

DETROIT X-RAY AND RADIUM SOCIETY *Secretary Treasurer*, E R Witwer, M D, Harper Hospital, Detroit 1 Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary Treasurer*, R B MacDuff, M D, 220 Genesee Bank Building, Flint 3

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C N Borman, M D, 802 Medical Arts Bldg, Minneapolis 2 Regular meetings in the Spring and Fall

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, John W Walker, M D, 308 E 12th St., Kansas City, Mo Meetings last Friday of each month

ST LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Edwin C Ernst, M D, 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month October to May

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY *Secretary Treasurer*, O A Neely, M D, 924 Sharp Building, Lincoln Meetings third Wednesday of each month at 6 P.M in either Omaha or Lincoln

New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene M D, Massachusetts Memorial Hospitals, Boston Mass Meets monthly on third Friday at Boston Medical Library

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary Treasurer*, Albert C Johnston M D, Elliot Community Hospital, Keene. Meetings quarterly in Concord

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, W H Seward, M D Orange Memorial Hospital,

Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J Francis, M D, East Rockaway, L I

BROOKLYN ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Abraham H Levy, M D, 1354 Carroll St., Bklyn 13 Meets fourth Tuesday of every month October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C Gian, M D, 610 Niagara St., Buffalo 1 Meetings second Monday evening each month, October to May, inclusive.

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary-Treasurer* Dwight V Needham, M D 608 E Genesee St, Syracuse 10 Meetings in January, May and October

LONG ISLAND RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY *Secretary*, Wm. Snow, M D, 941 Park Ave., New York, 28

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary*, Murray P George, M D, 280 Crittenden Blvd., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary Treasurer*, James E Hemphill, M D, Professional Bldg Charlotte 2 Meets in May and October

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman M D 1338 Second St, N, Fargo

Ohio

OHIO RADIOLOGICAL SOCIETY *Secretary*, Henry Snow, M D 1061 Reibold Bldg, Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Hugh A Baldwin, M D 347 E State St, Columbus

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, George L Sackett M D 10515 Carnegie Ave. Cleveland 6 Meetings at 6 30 P.M on fourth Monday, October to April inclusive.

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists) *Secretary-Treasurer*, Samuel Brown M D 707 Race St Cincinnati 2 Meets third Tuesday of each month

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Peter M Russo M D 230 Osler Building Oklahoma City Meetings three times a year

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in the vicinity of the sella, they are much less common and are not likely to show the delicate flecks of calcification so characteristic of craniopharyngioma. In 10 of the patients in this series no diagnostic difficulties were encountered.

All of the 16 patients with craniopharyngiomas were treated by surgical exposure of the cyst by transfrontal craniotomy with aspiration of the contents and removal of as much of the cyst wall as was readily available in each instance. Five of the children are now alive, a survival rate of 31 per cent. Only 2 of these can be considered 'cures' from the standpoint of significant survival. One boy although retarded in growth, has normal vision and has lived for thirteen years without evidence of recurrence since the partial removal of the cyst. The other patient, also a boy, is totally blind but has had no return of symptoms for ten years.

The authors' experience with irradiation in these cases is too limited to warrant any conclusions, but on the basis of that of Davidoff and others, they feel that a critical appraisal should be made of roentgen therapy, as an adjunct to surgery, for these tumors.

Method of Ventricular Fluid Replacement Following Ventriculography. Arthur A. Morris. *J Neurosurg* 3: 351-354, July 1946.

A method of replacing ventricular fluid following ventriculography is described. This procedure is often desirable in hydrocephalus of congenital origin, especially in cases due to a periaqueductal stenosis.

Odontoma of the Nasopharynx. George McClure. *Arch Otolaryng* 44: 51-60, July 1946.

The author reports what he believes is the first case of odontoma of the nasopharynx to be recorded. A firm growth was discovered in the pharynx at the time of tonsillectomy when the patient was seven years of age. For three years no appreciable increase in size of the mass was noticed. At twelve years of age, the patient complained of difficulty in hearing, frequent sore throats and her speech was somewhat thickened. Left lateral roentgenograms of the neck showed a tooth, apparently a molar, in the left posterior area of the pharynx. It did not appear attached to any bone. There was slightly increased density around it, probably due to remnants of the tooth bud. A diagnosis of non-malignant embryonic bony tumor was made and the mass was excised. Pathologic examination showed a benign osteofibroma (dentigerous origin—tooth in malposition). Seven years later the growth had returned. Stereoscopic left lateral and submentovertex views of the skull revealed a dense shadow resembling a dental structure in the posterior wall of the pharynx, on the left side in the region of the orifice of the eustachian tube. Surrounding this shadow was a larger shadow of lesser density which appeared to be calcification with a cyst wall. It was thought that a dermoid cyst was lying in the posterior wall of the nasopharynx. The recurring tumor with the deciduous tooth was removed. The recurrence of the growth and the formation of a second deciduous tooth definitely put the tumor in the classification of compound composite odontoma.

Chronic Phosphorus Poisoning. H. Heumann. *J Indust Hyg & Toxicol* 28: 142-150, July 1946.

Three cases of chronic yellow phosphorus poisoning are presented. In each instance, a jaw was involved.

The first patient complained of rheumatic pain, and several teeth were extracted, with no relief of the joint pains and aggravation of the jaw pain. A diagnosis of osteomyelitis of the lower jaw was made and the relationship of the patient's condition to his occupation went unrecognized for some time. In the other two cases the diagnosis was made earlier and therapy instituted promptly. In one instance the upper jaw was involved, and it was found that such a case responds poorly to any type of therapy. Preventive measures are outlined. Roentgenograms are reproduced in 2 cases.

THE CHEST

The Lateral Decubitus Position in X-Ray Examination of the Chest. Samuel Richman. *J Mt Sinai Hosp* 13: 83-85, July-August 1946.

The lateral decubitus position in x-ray examination of the chest is of particular value for the following purposes and under the following conditions:

(1) To demonstrate a fluid level in the chest in patients who are too weak to assume an upright position. The left decubitus position may also be used to determine the presence of free air under the diaphragm in cases of suspected perforated peptic ulcer, etc.

(2) To differentiate the character of effusion in the pleural cavity.

(3) In females where the breast tissue frequently obscures the lower lung fields, especially the costophrenic sinuses. Comparison of a film taken in lateral decubitus with one in the usual upright position showing the persistence or non-persistence of shadows, may be of considerable aid in differential diagnosis.

(4) In the presence of fluid in the pleural cavity. The position and appearance of the diaphragm can be more easily made out than in the upright film.

(5) In patients in whom the fluid in the pleural cavity presents an atypical appearance in the upright position.

(6) To reveal in greater detail the pathologic change in the lateral peripheral (axillary) portion of the lung. Due to the crossing of the ribs in this region, fine lung detail is difficult to distinguish. In the lateral decubitus position the shift of the mediastinum and the lung tends to bring into view more of the lateral peripheral lung area thus enabling one to see more clearly any change occurring there.

It is suggested that the lateral decubitus position be used more frequently, especially in cases of suspected disease in the region of the diaphragm and costophrenic sinus. Illustrative roentgenograms are reproduced.

A Light, Compact X-Ray Generator of High Efficiency for Mass Radiography of the Chest. Russell H. Morgan and Emmet G. Murphy. *Pub Health Rep* 61: 982-989, July 5 1946.

The authors describe and set forth the advantages of a small light weight x-ray generator capable of operation from 110 volt domestic power lines. There is increasing need for a unit of this sort in mass radiography of the chest. It is a constant-potential generator making use of two condensers in the circuit. The article demonstrates graphically the greater brightness obtained from the photofluorographic screen when the x-ray tube potential is constant. The tube screen distance is reduced to 30 inches, thus limiting exposure times and decreasing the quantity of heat generated within the x-ray tube. As a result of the above factor, the generator may be operated as quickly as photofluoro-

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Congenital Anomaly and Fracture of the Atlas
J W Wilson and N M Brown Canad M A J
55 52-53, July 1946

Two cases are briefly reported—a congenital defect in the posterior arch of the atlas discovered following an accident and a fracture of the atlas. A short discussion of Jefferson's work (Brit. M J 2 153 1927) is presented in which an attempt was made to dispel the belief that fractures of the atlas carry a high mortality rate and that they are very rare. Hinchey and Bickel (Ann Surg 121 826, 1945 Abst in Radiology 46 422, 1946) are also quoted as having found an over all mortality rate of 10.7 per cent in a collected series of 112 fractures of the atlas. PHILIP W DORSEY M D

Early Diagnosis in Tumours of the Central Nervous System
W Lister Reid M J Australia 1 865-872,
June 22, 1946

The author has sought in this paper to present in abbreviated form the more important points to be considered in the early diagnosis of intracranial and intraspinal expanding lesions. Among the significant features is the progressive nature of the symptoms and signs. These are taken up individually and a detailed outline for neurologic examination is included. Under the heading "Subjective Symptoms" are considered headache, epileptiform seizures, vomiting, ataxia, vertigo, dysphagia, and mental symptoms. As to the last, the author is emphatic, cautioning against the error of attributing these to a psychoneurosis without definitely ruling out an intracranial expanding lesion, or misinterpreting tumor symptoms engrafted on a previous hysteria. "Objective findings" to be sought for include septic foci, extracranial new growths, changes in blood pressure (chiefly from the standpoint of differential diagnosis), and cranial nerve and motor disturbances.

Roentgen examination is considered under the heading "Special Methods of Investigation" along with spinal, cisternal and ventricular puncture, biopsy, and manometric tests. The x ray findings receive adequate comment—the things we usually look for and seldom find as changes in the vascular channels (of doubtful significance in the abstractor's opinion), erosion, hyperostosis, pineal shift, etc. Ventricular air studies furnish the most valuable information with regard to the presence and localization of intracranial lesions. The author deserves hearty commendation for striking sharply at the use of thorotrast which he says may produce ependymitis when injected into the ventricles as well as an inflammatory reaction in the subarachnoid space, sometimes extending along the sheaths of the optic nerves. The chief field for this medium is arteriography, but for demonstration of neoplasms the author prefers air studies as safer and of greater diagnostic efficiency. Lipiodol has been of value in localizing intraspinal lesions but has the disadvantage of being non-absorbable.

The following conclusions are reached. It is doubtful if it will ever be possible to carry out a successful removal of malignant neoplasms involving the basal ganglia, mid brain, pons or medulla. Also it is very questionable if it is justifiable to remove cerebral meta-

static tumours or rapidly growing gliomata. Excellent results, however, are obtained with the less malignant gliomata and with non malignant tumours, provided that they have not progressed to the state at which essential cerebral or spinal function is interfered with.

Every patient with symptoms referable to the central nervous system which become progressively worse should be regarded as a tumour suspect until proved otherwise and should be subjected to a complete neurological investigation, including examination of the cerebro-spinal fluid and ventricular air studies.

PERCY J DELANO, M D

Cranio-pharyngiomas in Children. Franc D Ingraham and H William Scott, Jr J Pediat 29 95-118
July 1946

Sixteen children with craniopharyngiomas were treated by the surgical services of the Children's Hospital and the Peter Bent Brigham Hospital from 1932 to 1945 inclusive. Two of the cases are presented in detail. The embryologic and pathologic aspects of the tumors are discussed.

In general, the presenting symptomatology of craniopharyngiomas in the 16 children at the time of initial hospitalization was characterized by intracranial hypertension as manifested by headache and vomiting (15 cases) associated with progressive loss of vision (9), arrested skeletal development (5) and uncommonly with diabetes insipidus and the overt forms of hypothalamic disorders. Changes in the optic disks were present in all 16 patients. Visual field determinations could be carried out in 13. Essentially normal fields were found in 5 instances, 5 patients had bitemporal hemianopsia or bitemporal quadrantic defects, 1 showed a right homonymous hemianopsia and 2 had lost all vision in the field of one eye and had temporal defects in the other eye field. Ten children were essentially normal in size, development and physical appearance. Blood and urine studies at the time of hospitalization were not unusual except for low specific gravity of the urine in 3 patients with diabetes insipidus.

Roentgenograms of the skull showed definite abnormalities in all of the patients. Calcification above the sella turcica was present in 8 cases and intrasellar calcification in 2 others. This finding is almost pathognomonic of the tumor in children. The visible calcification is most often present in the solid basal portion of the tumor appearing in the roentgenogram as a collection of delicate spongy opaque flecks. Rarely, there may be large masses of calcium and still more rarely, part of the cyst wall may be outlined by calcification. Roentgen evidence of increased intracranial pressure as indicated by separated sutures, convoluted atrophy or erosion of the clinoid processes was observed in 7 children. The sella turcica was enlarged and distorted in one half the cases. Usually the enlargement of the fossa is of an irregular type with depression of the floor and is associated with erosion of the dorsum sellae or posterior clinoid processes.

With a history of failing vision, headaches and vomiting and the roentgen finding of calcification in or above the sella turcica, a diagnosis of craniopharyngioma can usually be made unequivocally in children. Although dermoid cysts, chordomas and teratomas may occur

tion with further progression of the disease, thus the term "latent apical tuberculosis" is applied to them

In order to visualize the apices to best advantage, the author uses the posterior lordotic position. The roentgen tube is centered to the cassette and then is tilted upward 5° from the horizontal and lowered about 4 inches until the central ray again is centered to the cassette. The patient stands with his back to the cassette, hands on hips, shoulders against the cassette holder, feet about one foot forward, knees slightly bent, and the abdomen protruding in a position of lordosis.

Reproductions of roentgenograms are included to show the value of the method in delineating small apical lesions
L W PAUL, M D

Results and Experiences in Twenty-Five Cases of Phrenic Crushing with Pneumoperitoneum in Exudative Tuberculous Pleurisy R Rosenfeld Schweiz med Wchnschr 76 551-554, June 22 1946

The author treated 25 patients with tuberculous pleural effusion by first crushing the phrenic nerve and then inducing a pneumoperitoneum. Eighteen of these cases were primary, the other 7 were recurrences. In 7 cases the disease was bilateral. One patient, suspected of having a neoplasm, was made worse, in 5 cases there was no benefit, in 15 the results were good to excellent, and there were 4 apparent cures. Patients showed immediate benefit with fall of temperature following the operation.

The treatment should be continued over a four-month period for best results, although in occasional cases this time may be shortened to two months if necessary. The principal complication is mediastinal emphysema, and deaths have been reported in the literature as a result of this accident. In the present series, mediastinal emphysema was observed only once, and the patient recovered. As a measure to control the incidence of this accident the author recommends that only 800 to 1,000 c c of air be introduced at a sitting. In left sided disease the gastrocardiac symptom complex with pain in the shoulder may be observed following each filling. While this is not serious, it may be controlled by not exceeding 600 c c of air per filling.

The author believes that, while the method is not as yet an established one, it holds great promise in this type of disease
LEWIS G JACOBS, M D

Pneumonitis Occurring in Rheumatic Fever George C Griffith, A W Phillips, and Curtis Asher Am J M Sc 212 22-30 July 1946

Pneumonitis occurring in the course of rheumatic fever is characterized by an inflammatory process in the lung and pleura, with insidious onset, migrating consolidation, and frequently pleurisy, with or without effusion. This complication was found in 119 of a group of 1,046 rheumatic fever patients, most often in association with the acute and polycyclic types of the disease.

Gross examination shows areas of mottling which are characteristic of infarctions. These areas may be found in all lobes of the lungs. This histologic picture is that of an anaphylactic angitis involving the larger as well as the capillary vessels. Aschoff bodies may be found freely in various stages of development and maturity. In this series, effusion occurred in 10.9 per cent of the cases. The effusions which tend to be temporary, are sterile and straw colored to sanguineous in appearance.

At times, they contain large numbers of eosinophils. The effusion may absorb very rapidly with little residual evidence of pleurisy.

Primary acute pneumonitis may be, at times, the presenting manifestation of rheumatic fever. On physical examination, an area of dullness, which may develop into frank consolidation, may be found in one or more lobes. More frequently, the area clears after a few days and another area develops. After two or three days other manifestations, such as migrating polyarthritis, carditis, and a sustained relatively high temperature, appear. The course is severe and prolonged. It is the opinion of the authors that where there is primary right heart failure in rheumatic fever, pneumonitis is one of the initiating causes. Of the cases of acute fulminating rheumatic fever, 53.1 per cent had rheumatic pneumonitis, and in about one-half of these, the initial symptoms were referable to the lungs.

Secondary acute pneumonitis occurs during the course of established rheumatic fever, most often in the polycyclic type. It is usually one of the presenting symptoms of the second or third cycle.

Subclinical pneumonitis is found accidentally, since there are no symptoms and few, if any, signs. The diagnosis is based entirely on the roentgenographic findings.

The characteristic roentgen ray findings in rheumatic pneumonitis and pleuritis are the rapid onset and clearing of the densities found at the sites of the clinical findings and the sudden reappearance elsewhere in the lung fields. A pleural effusion may also appear and disappear rapidly. Multiple, and upper, lobe involvement occurred more frequently in the very ill patients. Effusion occurred in about 18 per cent of the cases with demonstrable pleurisy, but the incidence was much higher if pleural pain is taken as the diagnostic criterion.

The primary acute pneumonitis cannot be distinguished from primary atypical pneumonia, either clinically, by sputum studies, by roentgen ray, or by blood studies. It is only recognized when other manifestations of rheumatic fever appear. The signs which are most helpful in establishing the diagnosis are carditis, migrating polyarthritis, purpura, erythema marginatum, epistaxis and subcutaneous nodules. An onset of pneumonia with a chill is not found in rheumatic pneumonitis. In congestive failure, the air hunger and the increased venous pressures are more marked and there is an enlarged, pulsating tender liver. The laboratory aids are of little help in the differential diagnosis except in lobar pneumonia.

BENJAMIN COPEMAN, M D

Tomography in the Diagnosis of Lung Carcinoma. J Blair Hartley Proc Roy Soc Med 39 531-534, July 1946

Tomography has been used in the diagnosis of pulmonary carcinoma in the Holt Radium Institute (Manchester, England) in part because of objections to the use of lipiodol on the part of the therapists, in part because of the limitations of bronchoscopy, and more specifically because of the desirability of ascertaining the exact depth of the lesion so that, if roentgen therapy is desired, it can be directed to the proper level.

The technic employed is described by the author as rather primitive, the simple attachment used being merely a lever between the tube and the cassette tray. The length of the tube shift is between 12 and 15 inches, while the film shift is between 2 and 3 3/4 inches. The

graphic schedules can be maintained without overheating the tube. The complete unit weighs approximately 600 pounds. It supplies a distinct need in the field of photofluorography in mass surveys. M IVKER, M D

An Evaluation of a Chest X-Ray Resurvey of an Industrial Plant. Morton Kramer, George W Comstock, and Joseph B Stocklen. Pub Health Rep 61 990-1001, July 5 1946

The purpose of this paper is to report the results of two mass chest x ray surveys done with an interval of 18 months in a large industrial concern in Cleveland, Ohio. On the first survey (November 1943), photofluorograph equipment was adapted to the purpose and did not include a phototimer. Perforated 35-mm film was used. The subjects were required to strip to the waist and don paper jackets. For the second survey (May 1945) equipment designed for survey procedures was used with a Morgan Hodges phototimer and Fairchild 70-mm camera. This time the employees remained clothed. The medical officers and other survey personnel were entirely different for the two surveys. The physicians reading the miniature films did not know that their interpretations were to be used for comparative study. The films in both surveys were read more hurriedly than is the usual practice. This was particularly true in the second project because of illness in the survey team. In the first survey 6 287 persons were examined, in the second 5,679.

The tuberculosis prevalence rate was 1.3 per cent in the first survey and 1.4 per cent in the second, both figures being slightly lower than the similarly determined rate of 1.6 per cent in 102,000 mass x ray examinations among the industrial population of Cuyahoga county (in which Cleveland is situated).

By comparing x rays of persons diagnosed as tuberculous on the 1945 survey with these taken in 1943 it was found that of 97 cases that should have been detected in 1943, 20 or 20.6 per cent were missed. Similarly by checking the films of persons diagnosed as tuberculous in 1943 against those of 1945 it was found that of 88 persons who should have been diagnosed as tuberculous in the 1945 survey, 10 or 11.4 per cent were missed.

Important factors in the erroneous diagnoses of 1943 are believed to be the eyestrain and fatigue involved in reading 35-mm films with the viewing equipment then available and the lack of phototiming.

In only 5 or 0.13 per cent of the 3 981 non tuberculous individuals in the 1943 survey did reinfection tuberculosis develop in the following eighteen months. Such a low incidence would indicate that a resurvey at an interval of eighteen months of persons previously known to be non tuberculous is of little value as a finding procedure. These findings indicate that once the tuberculosis status of the employees of a plant has been determined by a mass survey it would be of value to require preplacement examinations of all persons subsequently employed thereby affording earlier diagnosis for new employees with tuberculosis and more adequate protection to other persons in the plant.

BERT H MALONE M D

Miniature Photofluorography of the Clothed Subject. Ira Lewis. Pub Health Rep 61 1002-1004, July 5, 1946

The practical advantages in time saved confusion avoided, and efficiency gained from the examination of

clothed subjects in mass x ray procedures are obvious provided of course, that such practice produces results of a quality equal to that realized by the conventional examination of the unclothed subject. Radiologists of the Tuberculosis Control Division, United States Public Health Service, have interpreted, in the course of their duty throughout the country, tens of thousands of miniature films of clothed subjects. Their experience permits the persistent belief that clothing causes no diagnostic errors through obscuration, though no controlled tests to demonstrate the analogous qualities of products of the two procedures is known to have been made.

In view of these considerations the author examined a considerable number of persons both with and without clothing, reaching the following conclusions. There is no objection to clothed persons in chest survey programs. Speed of operation is increased, less dressing room space and personnel are required. This method moreover, will appeal to women and will attract greater numbers of persons to photofluorographic installations with a resultant accelerated action toward the objective of mass surveys (the x raying of every adult in the United States). Because of these many new examinees and because thousands of new cases of tuberculosis will be brought to medical attention, the x raying of clothed subjects even if conducive to a narrow margin of error would be the procedure of choice. Furthermore, it is reasonable to assume that factors other than clothing such as technical faults and subjective error inherent in some interpretations might well introduce greater diagnostic deviation. HUGH A O NEILL M D

Results of Mass Radiography of R.A.F. Ex-Prisoners of War from Germany. A G Evans. Brit M J 1 914-915, June 15 1946

On their return to Great Britain from German prison camps 9 142 Air Force personnel were subjected to mass radiography. Forty seven of the number were found to have active and 64 inactive tuberculosis. 50 had calcified nodules, 27 calcified hilar lymph nodes, and 51 calcified nodules and lymph nodes. In 57 per cent of the active cases the sputum was positive for tuberculosis. On questioning it was found that the food had been adequate until the last six months. As most of the men had been interned for one to four years it would appear that the high incidence of infection may be associated with close living quarters and a lowered resistance—in the first instance due to mental stress and later to actual malnutrition.

Non tuberculous conditions revealed by the survey included bronchitis, emphysema, bronchiectasis, pulmonary fibrosis, congenital abnormalities, acquired cardiovascular lesions, pleural thickening, aberrant pneumonic consolidation and shrapnel in the chest wall and lung fields. HENRY K TAYLOR M D

Apical Tuberculosis. Roentgenological Technique for Its Early Recognition with Some Pathogenetic Applications. Abraham J Flaxman. Am Rev Tuberc 54 1-8, July 1946

Fibrotic tuberculous lesions in the pulmonary apices are found frequently at autopsy; their incidence being considerably higher than is demonstrated by conventional chest roentgenography. Because these fibrous 'scars' may contain caseous areas with viable bacilli they may under certain conditions undergo reanima-

tion with further progression of the disease, thus the term "latent apical tuberculosis" is applied to them.

In order to visualize the apices to best advantage, the author uses the posterior lordotic position. The roentgen tube is centered to the cassette and then is tilted upward 5° from the horizontal and lowered about 4 inches until the central ray again is centered to the cassette. The patient stands with his back to the cassette, hands on hips, shoulders against the cassette holder, feet about one foot forward, knees slightly bent and the abdomen protruding in a position of lordosis.

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L. W. PAUL, M.D.

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The technic employed is described by the author as rather primitive, the simple attachment used being merely a lever between the tube and the cassette tray. The length of the tube shift is between 12 and 15 inches, while the film shift is between 2 and 3 3/4 inches. The

exposure is given as constant 100 ma for an average of two seconds. A lead diaphragm is used rather than a cone. To depict the bronchi tomograms are obtained at intervals of 1 cm, the usual levels being at 9 10 11 and 12 cm from the table top.

The author assesses the value of tomography under seven headings: (1) It confirms or rules out bronchial obstruction previously diagnosed. (2) It may demonstrate the size and/or depth of a carcinoma already diagnosed and reveal the true nature of lesions undiagnosed or inaccurately diagnosed. (3) It may reveal whether a carcinoma is of ulcerating or obstructing type, and whether the lesion is extensive and of the peribronchial infiltrating type. (4) It may bring out details not evident in the plain film. (5) It may reveal compression or displacement of air passages. (6) It may aid in follow up examination determining whether changes in the chest picture are the result of recurrence or incident to treatment. (7) The immediate and late results of radiation therapy are best discerned in this way.

As to the limitations of the procedure, the author states that it does not necessarily indicate the exact nature of the lesion, even though the definite point of obstruction can be outlined; it is frequently unreliable in determining how much of a lesion may be attributed to neoplasm and how much to inflammation, small lesions of the lungs, trachea and main bronchi are easily missed, and, finally interpretation is at best difficult.

It is concluded that while tomography cannot replace routine radiography of the chest, it should replace lipiodol bronchography where the case is likely to be one of carcinoma of the bronchus and where radiation therapy is indicated. SYDNEY F THOMAS, M D

Sarcoidosis (Besnier-Boeck-Schaumann's Disease) Report of a Case in a Child Simulating Still's Disease. Agustín Castellanos and Enrique Galán. *Am J Dis Child* 71: 513-529 May 1946.

A detailed report is made of a bizarre case recorded as the first instance of sarcoidosis observed at the Children's Hospital of Habana.

The patient, a 6-year-old white Cuban boy, was admitted to the hospital having fever, polyarthritis, a symmetric erythematous eruption on the face and arms, generalized adenopathy, dry cough, despite the presence of râles in both lungs, splenomegaly, mild uveitis and pin point non vesicular keratitis. The illness had an insidious onset three years before admission and had been gradually progressive.

Roentgen studies showed milary mottling in both lung fields suggesting tuberculosis, but gavage sputum cultures failed to reveal acid fast bacilli and negative reactions were obtained to tuberculin tests up to 1:100 dilution. Some thickening of the mucosa was noted in both antra. Soft-tissue swelling was evident about the large joints of all the extremities, being especially marked about the knee joints. No remarkable findings were present in the bones, including the phalanges.

Aspiration of the knee joints revealed a pus like material that proved to be sterile on culture. Biopsy of the synovial membranes showed non specific chronic inflammation. Tissue section of the left deltoid showed 6 to 10 nodules in the subcutaneous and muscle layers having the microscopic features of sarcoid granulomas. Cytodiagnostic puncture of the lung and aspiration of

sternal marrow yielded numerous histiocytes and multinucleated cells. Those found in the bone marrow were similar to the giant cells seen in Boeck's sarcoid.

A provisional diagnosis of Still's disease was made at first, based on the history of a gradual onset and prolonged fever, and on the findings of chronic polyarthritis deformans and splenomegaly. After further evaluation of the pulmonary findings, the eye lesions, the dermatitis, and the deltoid biopsy, the diagnosis was changed to sarcoidosis. The patient was discharged with some general improvement.

Four months later, the patient was readmitted because of dyspnea, remittent fever, and great weight loss. Roentgenograms now showed a right pleurisy with effusion, and after artificial pneumothorax consolidation in the right lower lobe. The tuberculin test, in 1:1000 dilution, gave a strongly positive reaction and an atypical Arthus phenomenon developed. Culture and inoculation examinations of the pleural effusion, joint exudate, and sputum still yielded no tubercle bacilli or any pyogenic bacteria. Biopsy of an inguinal node showed microscopic evidence of sarcoid.

The milary pulmonary lesions noted on the first admission and the protean systemic findings described above were considered as manifestations of sarcoidosis. The process present in the right lower lobe on the second admission was diagnosed as a complicating tuberculous lobitis.

A note appended to this report states that the patient eventually developed a Pott's abscess of the dorsal spine followed by a fatal tuberculous meningitis. An autopsy was not permitted.

LESTER M J FREEDMAN, M D

Congenital Cystic Disease of the Lung Joe Gardner. *New Orleans M & S J* 99: 15-21, July 1946.

This is a rather general review of the subject of congenital cystic disease of the lung. This condition the author points out has been reported under at least eighteen different designations as follows: (1) congenital cystic disease of the lung, (2) congenital cystic formation of the lung, (3) congenital malformation of the lung, (4) atelectatic bronchiectasis, (5) congenital bronchiectasis, (6) honeycomb lung, (7) pulmonary cysts, (8) emphysematous bullae, (9) vesicular pulmonary emphysema, (10) bullous emphysema, (11) pleural blebs, (12) chronic interstitial pneumonitis with emphysema, (13) pulmonary pneumatocoles, (14) pneumatocoele, (15) pneumocoele, (16) pneumocyst, (17) air cyst, and (18) balloon cyst of the lung.

Though not infallible the x ray is the most valuable diagnostic aid. Fluid-containing cysts show up as areas of increased density. The air-containing cysts appear as areas of decreased density with fine trabeculations. By injecting lipiodol and having the patient shift position it is possible to outline the cavity of a cyst communicating with a bronchus. Intracystic pressure reading may give some idea as to whether there is a patent connection with a bronchus.

The clinical and pathologic features of cystic disease of the lung are reviewed and a bibliography is appended. The author reports no case of his own.

Cystic Disease of the Lung Leon Sussman. *U S Nav M Bull* 46: 1105-1109 July 1946.

The increased use of x rays has disproved the presumed rarity of various pulmonary conditions among

them cystic disease of the lung This disease has been variously termed congenital bronchiolectasia, fetal bronchioectasis, congenital cystic disease of the lung, and honeycomb lung Three cases illustrating the variations in the condition are presented here, with roentgenograms in 2 cases

Acquired Syphilis of the Lung Report of a Case with Autopsy Findings and Demonstration of Spirochetes Joseph M Wilson Ann Int Med 25 134-146, July 1946

A case of acquired syphilis of the lung in a 69 year-old male is reported The patient had four plus Wassermann and Kahn reactions, and a roentgenogram of the chest suggested pulmonary syphilis After administration of potassium iodide for seven weeks, x ray examination showed a minimal regression in a right mid-lung density Death was due to bronchopneumonia Autopsy findings included, also, "syphilis of the right lung, acquired, gummata of bronchial lymph node, bronchiectasis, syphilitic aortitis"

The author considers roentgen study of pulmonary syphilis at best inconclusive although a necessary and valuable adjunct to the clinical diagnosis The presence in a syphilitic patient of a persistent unilateral hilar or lower lobe density with fibrous strands extending out toward the pleura, deserves serious consideration as a manifestation of pulmonary syphilis, though, other more common disease processes produce a similar picture, namely, pulmonary tuberculosis, mediastinal neoplasms, bronchiectasis, pneumoconiosis mycotic infection, and unresolved pneumonia Warring (Am Rev Tuberc 40 175, 1939) is quoted as declaring that the roentgen ray is an "inadequate differentiator" of pulmonary syphilis and is convinced that this condition cannot be diagnosed clinically Serial roentgenograms are essential in determining the response of the pulmonary lesion to antisyphilitic therapy The author believes, however, that too great reliance should not be placed on such response, as antisyphilitic therapy may also cause regression of non-syphilitic lesions

Bronchial Stenosis and Atelectasis from Sulphur Dioxide. W A Murray Canad M A J 54 399-600, June 1946

Sulfur dioxide, found where sulfur is burned used also as a disinfectant, bleaching substance and refrigerant, is an irritating gas which in contact with the moisture of the respiratory tract oxidizes to sulfurous acid Persons exposed to mild concentrations of the gas complain of headache cough, chest constriction, and gastro-intestinal disorders Asphyxia acute catarrhal bronchitis, pulmonary edema, and even death may occur

The case is reported of a 40 year old refrigerator repair man who experienced several attacks of cough, chest pain and expectoration following exposures to sulfur dioxide Successive postero-anterior films reproduced here showed an increased density in the left lung field unchanged for two and one half years (no lateral exposures are included) This was explained on the basis of a partial stenosis of the main bronchus to the left lower lobe with associated atelectasis and pneumonitis Bronchoscopy showed no definite stenosis but bronchography disclosed a lack of filling of the pectoral branch bronchus of the left upper lobe

RUSSELL WIGH, M D

Diagnosis and Management of Severe Infections in Infants and Children A Review of Experiences Since the Introduction of Sulfonamide Therapy V. Staphylococcal Empyema The Importance of Pyopneumothorax as a Complication Gilbert B Forbes J Pediat 29 45-67, July 1946

This paper is a review of 42 cases of acute staphylococcal empyema seen at St. Louis Children's Hospital from 1934 to 1943, inclusive This series does not include cases of empyema which developed during the course of staphylococcal sepsis, nor those chronic cases which were admitted for adequate drainage Cases of empyema following aspiration of a foreign body and those subsequent to surgical lobectomy or pneumonectomy are also excluded Twenty-seven patients were under one year of age None of the series received penicillin

The onset of the underlying staphylococcal pneumonia in these cases was usually gradual The child had an upper respiratory infection with coryza for several days, followed by fever, cough, rapid respirations, anorexia, and listlessness Soon a rather sudden turn for the worse took place and the patient became cyanotic and dyspneic, with marked evidence of toxemia

Physical signs of pulmonary empyema may be misleading in the young infant The most suggestive finding is a pneumonic involvement of an entire lung field An accurate diagnosis can be made only by fluoroscopic or roentgenographic examination In uncomplicated staphylococcal empyema, the picture is identical with that of empyema due to other organisms except that the effusion more frequently occupies an entire lung field The appearance of pyopneumothorax merits particular attention A large collection of fluid and air immobility of the corresponding leaf of the diaphragm, and rather marked displacement of the mediastinum are characteristic roentgen findings The pocket of fluid and air may, however, be small if the pyopneumothorax has developed late in the disease and is limited by preformed adhesions, or several such pockets may be arranged in such a manner as to suggest congenital cystic disease of the lung The presence of air and fluid in the pleural space of an infant should immediately suggest staphylococcal disease of the lung Pyopneumothorax complicated 17 cases in this series (40.5 per cent) It was a direct cause of death in one patient and contributed in large part to the death of another

The mortality rate for the 10 cases seen in the first half of the period under consideration was 60 per cent, and for the second period (32 cases), after sulfapyridine came into wide usage 15.6 per cent, for the entire period 26.2 per cent

General supportive measures and surgical drainage constituted the two most important aspects of treatment The use of closed intercostal siphon drainage is advocated as a means of obviating the possibility of tension pyopneumothorax and at the same time providing adequate drainage The sulfonamide drugs and antistaphylococcal serum were of limited usefulness Ten case histories are included

Massive Dermoid Cyst of the Mediastinum, with Report of a Case Samuel A Loewenberg, Samuel Baer, and William T Lemmon Ann Int Med 24 1096-1105, June 1946

Dermoid cysts may remain small or may grow rapidly in adolescence or early adult life They usually

exposure is given as constant 100 ma. for an average of two seconds. A lead diaphragm is used rather than a cone. To depict the bronchi, tomograms are obtained at intervals of 1 cm., the usual levels being at 9, 10, 11, and 12 cm. from the table top.

The author assesses the value of tomography under seven headings: (1) It confirms or rules out bronchial obstruction previously diagnosed. (2) It may demonstrate the size and/or depth of a carcinoma already diagnosed and reveal the true nature of lesions undiagnosed or inaccurately diagnosed. (3) It may reveal whether a carcinoma is of ulcerating or obstructing type and whether the lesion is extensive and of the peribronchial infiltrating type. (4) It may bring out details not evident in the plain film. (5) It may reveal compression or displacement of air passages. (6) It may aid in follow up examination determining whether changes in the chest picture are the result of recurrence or incident to treatment. (7) The immediate and late results of radiation therapy are best discerned in this way.

As to the limitations of the procedure, the author states that it does not necessarily indicate the exact nature of the lesion even though the definite point of obstruction can be outlined. It is frequently unreliable in determining how much of a lesion may be attributed to neoplasm and how much to inflammation, small lesions of the lungs, trachea, and main bronchi are easily missed, and, finally, interpretation is at best difficult.

It is concluded that, while tomography cannot replace routine radiography of the chest, it should replace lipiodol bronchography where the case is likely to be one of carcinoma of the bronchus and where radiation therapy is indicated. SYDNEY F. THOMAS, M.D.

Sarcoidosis (Besnier-Boeck-Schaumann's Disease). Report of a Case in a Child Simulating Still's Disease. Agustín Castellanos and Enrique Galán. *Am J Dis Child* 71: 513-529 May 1946.

A detailed report is made of a bizarre case recorded as the first instance of sarcoidosis observed at the Children's Hospital of Habana.

The patient, a 6 year old white Cuban boy, was admitted to the hospital having fever, polyarthritis, a symmetric erythematous eruption on the face and arms, generalized adenopathy, dry cough despite the presence of râles in both lungs, splenomegaly, mild uveitis, and pin point non-vesicular keratitis. The illness had an insidious onset three years before admission and had been gradually progressive.

Roentgen studies showed milary mottling in both lung fields suggesting tuberculosis, but gavage sputum cultures failed to reveal acid fast bacilli and negative reactions were obtained to tuberculin tests up to 1:100 dilution. Some thickening of the mucosa was noted in both antra. Soft-tissue swelling was evident about the large joints of all the extremities, being especially marked about the knee joints. No remarkable findings were present in the bones including the phalanges.

Aspiration of the knee joints revealed a pus like material that proved to be sterile on culture. Biopsy of the synovial membranes showed non specific chronic inflammation. Tissue section of the left deltoid showed 6 to 10 nodules in the subcutaneous and muscle layers, having the microscopic features of sarcoid granulomas. Cytopathologic puncture of the lung and aspiration of

sternal marrow yielded numerous histiocytes and multinucleated cells. Those found in the bone marrow were similar to the giant cells seen in Boeck's sarcoid.

A provisional diagnosis of Still's disease was made at first, based on the history of a gradual onset and prolonged fever and on the findings of chronic poly arthritis deformans and splenomegaly. After further evaluation of the pulmonary findings, the eye lesions, the dermatitis, and the deltoid biopsy, the diagnosis was changed to sarcoidosis. The patient was discharged with some general improvement.

Four months later, the patient was readmitted because of dyspnea, remittent fever, and great weight loss. Roentgenograms now showed a right pleurisy with effusion, and after artificial pneumothorax, consolidation in the right lower lobe. The tuberculin test, in 1:1000 dilution, gave a strongly positive reaction and an atypical Arthus phenomenon developed. Culture and inoculation examinations of the pleural effusion, joint exudate, and sputum still yielded no tubercle bacilli or any pyogenic bacteria. Biopsy of an inguinal node showed microscopic evidence of sarcoid.

The milary pulmonary lesions noted on the first admission and the protean systemic findings described above were considered as manifestations of sarcoidosis. The process present in the right lower lobe on the second admission was diagnosed as a complicating tuberculous lobitis.

A note appended to this report states that the patient eventually developed a Pott's abscess of the dorsal spine followed by a fatal tuberculous meningitis. An autopsy was not permitted.

LESTER M. J. FRIEDMAN, M.D.

Congenital Cystic Disease of the Lung. Joe Gardner. New Orleans M. & S. J. 99: 15-21, July 1946.

This is a rather general review of the subject of congenital cystic disease of the lung. This condition the author points out has been reported under at least eighteen different designations, as follows: (1) congenital cystic disease of the lung, (2) congenital cystic formation of the lung, (3) congenital malformation of the lung, (4) atelectatic bronchiectasis, (5) congenital bronchiectasis, (6) honeycomb lung, (7) pulmonary cysts, (8) emphysematous bullae, (9) vesicular pulmonary emphysema, (10) bullous emphysema, (11) pleural blebs, (12) chronic interstitial pneumonitis with emphysema, (13) pulmonary pneumatocoles, (14) pneumatocoele, (15) pneumocoele, (16) pneumocyst, (17) air cyst, and (18) balloon cyst of the lung.

Though not infallible the x-ray is the most valuable diagnostic aid. Fluid-containing cysts show up as areas of increased density. The air-containing cysts appear as areas of decreased density with fine trabeculations. By injecting lipiodol and having the patient shift position it is possible to outline the cavity of a cyst communicating with a bronchus. Intracystic pressure reading may give some idea as to whether there is a patent connection with a bronchus.

The clinical and pathologic features of cystic disease of the lung are reviewed and a bibliography is appended. The author reports no case of his own.

Cystic Disease of the Lung. Leon Sussman. U.S. Nav. M. Bull. 46: 1105-1109, July 1946.

The increased use of x-rays has disproved the presumed rarity of various pulmonary conditions among

Removal of Shell Fragment from Left Ventricle of the Heart. Report of a Case. William B. Schaefer and Victor R. Satinsky. *Arch. Surg.* 53: 13-23, July 1946

The authors report the removal of a myocardial foreign body. They point out that while there is still a difference of opinion as to the advisability of elective removal of a foreign body from the myocardium, the majority of authors favor the procedure. The dangers of permitting a foreign body to remain in the heart muscle are three: (1) cardiac rupture, (2) migration to the cardiac cavity with embolus formation or interference with cardiac function, (3) injury to the coronary vessels.

The case reported is that of a soldier who was struck by a mortar fragment in the back. A massive left hemothorax developed in which x-rays demonstrated the presence of a metallic foreign body. Fluoroscopy showed that the foreign body moved synchronously with the heart. At operation a large amount of clotted blood and serosanguineous fluid was removed. After decortication of the lung the heart was exposed, the foreign body was located near the apex, and removal effected. It was apparent that the shell fragment entering posteriorly, had cut through the lung and struck the anterior chest wall, from which it was reflected to penetrate the heart. Hemostasis was secured by suture and the patient recovered, with satisfactory regression of the residua. The electrocardiograms taken postoperatively showed considerable abnormality of the ST segments, these being elevated at the beginning but later more normal in appearance. An initial diphasic T wave became a normal wave. The authors stress the importance of early and consistent exercises in rehabilitation.

LEWIS G. JACOBS, M.D.

Roentgen Diagnosis of Double Aortic Arch and Other Anomalies of the Great Vessels. Edward B. D. Neuhauser. *Am. J. Roentgenol.* 56: 1-12, July 1946

Anomalies of the great vessels result from persistence of normally obliterated arches or segments of the six pairs of aortic arches that develop at various times in the embryo, with disappearance of portions that should normally be present.

In the presence of a right aortic arch the aortic knob is not seen in its usual position and the aortic arch may be observed to the right of the mid-line. In the posterior type the aorta passes to the left behind the esophagus and the descending aorta courses to the right of the normal left-sided position. In all types of posterior right aortic arch the basic deformity of deviation of the esophagus to the left with a rounded defect on the right lateral aspect and on the posterior aspect of the esophagus will be evident. In rare instances a vascular ring may be formed by the pulmonary artery and ductus arteriosus or ligamentum arteriosum. In the patient with evidence of tracheal and esophageal compression operative intervention to relieve the constriction is imperative.

The onset of symptoms produced by a constricting double aortic arch is usually in infancy and the patient usually presents stridulous breathing, mild dysphagia, head retraction, chronic cough and frequent attacks of lung infection. In lateral roentgenograms it is possible to see narrowing and anterior displacement of the trachea at the level of the aortic arch. The posterior right aortic arch displaces the esophagus forward. Erosion of the anterior aspect of the thoracic vertebrae

can occur. In the anteroposterior view there is a narrowing of the esophagus from both the right and left sides, due to the pressure of the vascular ring. The trachea shows a similar narrowing.

A right subclavian artery arising as the last branch of the aortic arch will in most instances pass behind the esophagus and produce a characteristic small, oblique filling defect of this organ. When the vessel passes in front of the esophagus, a similar defect is produced on the anterior aspect of this structure.

These anomalies can no longer be considered rare. Roentgenographic studies afford the only means by which a certain diagnosis can be established. Prompt surgical treatment should yield satisfactory relief of the disabling symptoms produced by esophageal and tracheal compression.

CLARENCE E. WEAVER, M.D.

Anomalous Right Subclavian Artery Originating on the Left as the Last Branch of the Aortic Arch. Report of a Probable Case Diagnosed Roentgenologically. Herbert M. Stauffer and Harry H. Pote. *Am. J. Roentgenol.* 56: 13-17, July 1946

The anomalous right subclavian artery results from interruption of the right aortic arch cephalad to the origin of the primordial right subclavian. The latter then arises from the cephalic end of the unpaired dorsal aorta and passes cephalad and to the right, usually dorsad to the esophagus. The striking roentgenologic finding is the presence of a small semicircular indentation in the dorsal aspect of the barium-filled esophagus at the level of the upper margin of the aortic arch. This impression is attributed to the aneurysmal origin of the anomalous subclavian artery. The vessel courses upward and to the right. It occasionally passes between the esophagus and the trachea. The impression on the esophagus is best seen in the left anterior oblique view.

A case is described in a man aged 22 years who complained of a pulling pain in the left side of the chest, radiating to the right shoulder, which had been present on effort for seven years. There was an indentation of the esophagus on the posterior wall above the level of the aortic arch. In the anterior view there was a small convex shadow above the aortic knob on the left side, and this showed pulsation. It is postulated that in this case both the diverticulum-like origin and the esophageal imprint of the anomalous right subclavian artery itself were recognizable.

CLARENCE E. WEAVER, M.D.

Patent Ductus Arteriosus. Wm. C. Stewart. *West Virginia M. J.* 42: 171-176, July 1946

It is estimated that patent ductus arteriosus accounts for 10 to 15 per cent of all cases of congenital heart disease and that there are about 20,000 cases of this anomaly in the United States today. The author makes a careful evaluation of each of 5 cases presenting the criteria for diagnosis and the factors influencing the treatment. He considers the mere diagnosis of patent ductus arteriosus insufficient indication for operation. Each case must be considered on its own merits and in the light of previous experience, with due consideration of what may be expected from operation or from conservative treatment and no operation.

Factors opposing surgical treatment are listed as follows: (1) The patient is quite well and has very little disability. (2) The operation is a formidable one and even in the best hands carries a certain risk. (3)

remain dormant until the third or fourth decade, when they begin to enlarge and produce pressure symptoms. The predominant symptoms depend upon the size of the mass and the amount of pressure exerted on contiguous structures. There are usually cough, dyspnea, and chest pain. The physical signs also depend upon the size of the tumor and upon its influence on adjacent mediastinal organs. Thus one may encounter an upper or a lower mediastinal syndrome or physical signs resembling any of the following conditions from which a dermoid cyst must be differentiated: (1) tuberculosis, (2) pleural effusion or empyema, (3) lung abscess, bronchiectasis, pneumonitis, (4) mediastinal tumor, carcinoma, sarcoma, Boeck's sarcoid, gumma, thymoma, leukemia, Hodgkin's disease, (5) pericarditis, pericardial effusion, (6) aortic aneurysm. The differential diagnosis can be made, or at least suggested, by thorough radiological studies. Infrequently the diagnosis is established by expectoration of hair or aspiration of hair during diagnostic puncture as happened in the authors' case. All observers emphasize the risk involved in diagnostic paracentesis.

Operation is the only method of treatment and should be performed when disquieting symptoms occur. Such operative complications as rupture of the cyst into adjoining structures, formation of a cyst, bronchial fistula, and infection of the remaining portion of a partially removed cyst require special management.

The solid teratomata are more apt to become malignant and the dermoid cysts more frequently become infected. Rapid growth may occur in the presence of an intercurrent infection. The onset of infection in a cyst may at times be sudden, dramatic, and ominous. If the cyst communicates with a bronchus, large quantities of pus may be expectorated. A number of cases have been reported in which rupture of an infected cyst into the pleural cavity produced the clinical picture of chronic empyema.

A case is reported which presented practically all of the symptoms and signs and many of the complications mentioned above. When the patient was first seen, pericardial disease was considered a strong possibility, and this impression was supported by the presence of cyanosis, hepatomegaly, and peripheral edema. The correct diagnosis was suggested roentgenographically and confirmed by the aspiration of hair on thoracentesis.

It is generally agreed that removal of the cyst *in toto* is the treatment of choice. Since this was not possible in the authors' case, the cyst contents were evacuated and the secreting surface extensively cauterized in two stages. Eventual refilling of the cyst remains a possibility.

STEPHEN N. TAGER, M.D.

Calcification of the Pleura. C. F. Taylor and L. K. Chont. *J. Kansas M. Soc.* 47: 293-296, July 1946.

Calcification of the pleura is a relatively rare pathologic condition. The authors record 9 cases encountered in 6,301 patients undergoing roentgen examination for disease of the chest in seven and a half years. Tuberculosis is declared to be the causative factor by some authorities and denounced by as many others. The authors regard the calcification as the end result either of tissue repair following degeneration, necrosis, or of incomplete absorption of pleural effusion or fibrosis, or of incomplete absorption of pleural hemorrhage. They believe it may be caused by any infection or trauma where the tissue damage is sufficient to be followed by hyaline degeneration, necrosis, or fibrosis. In their series 4

patients showed definite roentgen signs of tuberculosis, and 3 of these had positive sputum. Three of the 9 patients gave a history of previous rather severe injury to the chest wall.

The physical signs of this condition are those of pleural effusion, namely diminished fremitus, percussion, and breath sounds and in certain cases, retraction of the thoracic cage with decrease or absence of respiratory movements. On the roentgenogram, the appearance is characteristic. Usually there are flat plaques of calcium density forming an irregular network. The lesion is usually on the lateral aspect of the lung. In advanced cases, it envelops the lateral part of the lung as a perforated shell. Retraction of the lung from the chest wall at the site of the lesion is common in advanced cases.

BERNARD S. KALAJIAN, M.D.

Angles of Clearance. A Method for Measuring the Cardiac Size of Children with Rheumatic Heart Disease (A Comparison with the Cardiothoracic Index). C. Berkeley McIntosh and Robert L. Jackson. *Am. J. Dis. Child.* 71: 357-364, April 1946.

Seventy-seven children with rheumatic heart disease were studied to evaluate the relative accuracy of the angles of clearance compared with the cardiothoracic index in detecting small degrees of cardiac enlargement. The angles of clearance refer to the amount of rotation necessary to clear the left dorsal cardiac border from the transverse processes of the vertebrae and again from the vertebral bodies on fluoroscopic examination. The method used was a modification of Wilson's technique described in a previous report by Jackson and his associates (*Am. J. Dis. Child.* 68: 157, 1944; *Abst. in Radiology* 44: 514, 1945).

The patients were segregated into two sections. The first included only those children having known but inactive heart disease. Cardiac measurement was repeated over a two-year period, using both methods. The second section comprised those patients having active rheumatic heart disease. Examinations in this group were repeated every two weeks during the active phase, until the heart no longer changed in size. The purpose of this study was to determine how the two methods compared in demonstrating change in heart size.

It is concluded that the angles of clearance demonstrate a larger percentage of cardiac enlargement in rheumatic heart disease than does the cardiothoracic index, the second angle being of greater value than the first. The second angle of clearance was elevated above the high normal of 70 degrees in 68 per cent of the 77 rheumatic subjects. The first angle was above the normal of 57 degrees in 41 per cent, while the cardiothoracic index was above the normal value of 50 per cent in only 35 per cent of these patients. The greater accuracy of the angles over the index is best demonstrated in the group of subjects showing no enlargement on physical examination. Of 41 patients so classified, none had an elevated index, whereas 40 per cent had an increase of the second angle and 12 per cent had an abnormally high first angle of clearance.

Both the angles and the index followed the same trend during the active course of rheumatic fever. However, after the heart size becomes stabilized, many of the previously elevated indexes will have fallen to high normal levels while the angles of the same patients will remain increased over the upper limits of normal.

LESTER M. J. FREEDMAN, M.D.

Trans-Pyloric Prolapse of Redundant Gastric Mucosal Folds. W C MacKenzie, J W Macleod, and J L Bouchard. *Canad M A J* 54 553-558, June 1946

Two cases of proved transpyloric prolapse of redundant gastric mucosal folds are added to the literature. The etiology of this condition is unproved, but pre-existing gastritis and emotional factors are believed to play important roles. The author distinguishes two types of roentgen picture—the polypoid and the pyloric narrowing type. In the former, prominent rugae are seen running in every direction, and there is a rounded defect in the base of the duodenal cap. In the latter type, which is more unusual, there is constant and persistent narrowing of the prepyloric region, but, in spite of this, the appearance is not that of a true stenosis. It is rather that of a definite diminution of caliber without appreciable interference with the passage of the peristaltic waves, and without secondary dilatation of the stomach. The pylorus itself seems to be moderately elongated and perhaps broader than usual. The base of the cap may show a concave outline with or without a definite filling defect as in the former type. The mucosal pattern is difficult to demonstrate, but with pressure or with the patient supine one may sometimes make out a localized area of redundancy in the prepyloric rugae. Among conditions to be considered in the differential diagnosis are a prolapsing polyp and early prepyloric carcinoma.

Operation is indicated only if a polyp cannot otherwise be ruled out, if bleeding continues and if there is evidence of pyloric obstruction.

FRANCIS F HART, M D

Congenital Duodenal Obstruction. Roentgen Diagnosis by Insufflation of Air. Harry Z Mellins and Doris H Milman. *Am J Dis Child* 72 81-88, July 1946

Because of the significant improvement in results of surgical management of congenital duodenal obstruction, early roentgen diagnosis is important. The roentgen diagnosis is usually made with barium sulfate or swallowed air as the contrast medium. The danger of using barium sulfate lies in possible plugging of the anastomotic stoma, to be created in a future short-circuiting procedure and in the development of aspiration pneumonia.

Plain roentgenograms of the abdomen may be used but are subject to the limitation that in the first twelve to twenty-four hours the stomach and duodenum may be only slightly dilated and the duodenal curve may be poorly outlined by air. Thus accurate localization of obstruction will not be possible.

The procedure used by the authors is as follows. After plain roentgenograms of the abdomen are taken a Levin tube is passed into the infant's stomach and the gastric contents are aspirated. Then 60 to 90 c c of air are introduced under fluoroscopic guidance. The infant is rotated to the left and "spot" films are taken. At the end of the procedure the air is aspirated.

Two cases of duodenal obstruction, one intrinsic and the other extrinsic are presented together with roentgenograms and autopsy findings confirming the preoperative diagnoses. PAUL W ROMAN, M D

Duodenal Obstruction Complicating Cholecystectomy. Theodore L Vosseler and Allison J Vosseler. *Am J Surg* 72 121-124 July 1946

An eighteen year-old girl who had complained of

vomiting most of her life, was subjected to a cholecystectomy at which time nothing abnormal was found except an "hour-glass" gallbladder. Postoperatively, she continued to vomit and showed symptoms of upper intestinal obstruction. X ray examination with a small amount of barium passed through a Miller-Abbott tube showed partial obstruction in the distal third portion of the duodenum.

A second laparotomy was performed twenty-three days after the cholecystectomy, at which time changes were noted in the region of the duodenal-jejunal junction. These changes suggested an inflammatory process. Due to the poor condition of the patient, the operative wound was closed without further procedure. Slowly she regained intestinal function and was discharged from the hospital, improved, on the fifty-seventh day. She became strong and robust and had remained so for six and one-half years at the time of the report.

VERN W RITTER, M D

Malignant Lesions of the Duodenum. Claude F Dixon, A L Lichtman, Harry M Weber, and John R McDonald. *Surg, Gynec & Obst* 83 83-93, July 1946

The authors discuss and analyze 49 cases of malignant lesions of the duodenum exclusive of those found in the region of the papilla of Vater. Forty-four cases proved to be carcinoma, 2 sarcoma, 2 leiomyosarcoma, and 1 lymphangioendothelioma. The pathogenesis of malignant duodenal lesions is considered with respect to trauma, malignant degeneration within ulcers, primary malignant growth within Brunner's glands, and malignant degeneration of aberrant pancreatic tissue.

In the main, the patients were men in the sixth or seventh decade. Fourteen of the lesions occurred in the first part of the duodenum, 15 in the second, and 20 in the third part. Thirty-eight of the patients gave a history of obstructive symptoms and in 6 cases the principal finding was anemia due to loss of blood either by mouth or bowel.

Since 1939 duodenal neoplasm has been found in 20 cases and in every one the existence and location of the lesion were correctly determined by roentgenograms. In 12 of these cases subsequent pathologic examination confirmed the roentgen diagnosis. The roentgenologic criteria are identical with those for malignant lesions in other tubular portions of the gastro-intestinal tract.

Forty-five patients were operated on, but in 37 only exploration was done. The operative mortality rate due to procedures other than exploration was 22 per cent. Four patients underwent radical resection and 4 others segmental resection, local excision was done in one.

N P SALNER, M D

Jejunal Cancer—A Case Report. Imre Braun. *Am J Digest Dis* 13 234-237, July 1946

Primary malignant tumor of the small intestine is an infrequent lesion. It is usually an annular adenocarcinoma, constricting in type, metastasizing early to the mesenteric lymph nodes. The chief symptoms are cramps and epigastric discomfort, with spells of nausea and vomiting. The presence of occult blood in the stool is a valuable sign. X-ray examination may be of great help in establishing a correct diagnosis though the use of barium by mouth may constitute a definite hazard by completing an otherwise incomplete obstruction.

The treatment of choice is resection with entero-

Surgery can be resorted to if subacute bacterial endarteritis develops or if manifestations of cardiac failure are present or impending (4) In about 15 per cent of cases the ductus is found upon exploration to be inoperable

Factors favoring surgical treatment are (1) The life expectancy of the patient with patent ductus arteriosus is reduced by about twenty five years, and only a very few complete a normal span of life (2) Serious complications are almost certain to develop in the majority of patients sooner or later (3) When the patient is in good condition the mortality associated with surgical treatment is now very low, probably less than 5 per cent (4) Operation after subacute endarteritis has developed will cure only about 50 per cent of patients and after congestive failure has developed the outlook is probably no better

The author's first patient, aged nine months, was not operated upon because it was apparent that good cardiac reserve was being maintained and the child was making fairly good progress in development, was well nourished, had no cyanosis, and was able to carry out ordinary activities without difficulty

The second patient, a twenty one year-old housewife showed fairly good cardiac compensation but had a blood pressure of 120 systolic and 40 diastolic. Despite her good compensation but because of the low diastolic pressure she should have had surgical treatment. However it was not possible to follow up the case and the subsequent course is unknown

The third patient a twenty two year old man showed an adequate cardiac reserve enabling him to carry out ordinary exercise without dyspnea. The opinion of Dr A R Barnes of the Mayo Clinic in this case is quoted. Since his cardiac reserve is now adequate the cardiac silhouette not enlarged and the pulse pressure not seriously increased and since the possibility that subacute bacterial endarteritis will develop is only a possibility I would advise against surgical intervention at this time. In view of recent experience in the treatment of subacute bacterial endarteritis and endocarditis with large doses of penicillin the prospect of bringing about a cure of this condition should it arise, is exceedingly promising and hence the hazard of the occurrence of subacute bacterial endarteritis is much less formidable than formerly. If there is progressive loss of cardiac reserve prior to the age of thirty the question of surgical closure of the ductus would have to be considered.

The fourth patient a thirty four year-old woman, was not operated upon in view of her normal blood pressure and good compensation

The fifth case was that of a twenty seven year-old secretary who complained of pain at the apex of the heart aggravated at times by breathing. She experienced dyspnea on moderate exertion and was becoming progressively more dyspneic. The cardiac shadow was definitely enlarged and the heart action was very vigorous. This patient was operated upon with successful closure of the ductus. She has experienced no difficulty since and the heart size has diminished slightly

In the detailed consideration of points of differential diagnosis and treatment an excellent review of the literature has been made. The roentgen examination is of great importance and may be the key to the diagnosis. Fluoroscopy is particularly useful

J E WHITELEATHER M D

THE DIGESTIVE SYSTEM

Effect of Transthoracic Vagotomy Upon the Functions of the Stomach and Upon the Early Clinical Course of Patients with Peptic Ulcer. K. S. Grimson, H. M. Taylor, J. C. Trent, D. A. Wilson and H. C. Hill. South M J 39 460-471, June 1946

Two important mechanisms regulate gastric secretion and motility and may influence the development of peptic ulcer. One is hormonal or chemical and is usually activated by the presence of food in the stomach or duodenum. The other is nervous and responds to stimuli of neurogenic, psychogenic, or reflex nature. The visceral efferent and afferent fibers of the vagus are known to play an essential role in the neural regulation of gastric motor and secretory function.

Following the lead of Dragstedt and his associates (Proc Soc Exper Biol & Med 53 152 1943 Arch Surg 44 438 1942, Gastroenterology 3 450 1944, Surgery 17 742, 1945 Ann Surg 122 973 1945) the authors undertook to remove a portion of the vagus nerve by the subdiaphragmatic transthoracic approach, from patients with refractory peptic ulcer. Their study of the therapeutic and physiologic effects of the procedure were begun in June 1944 and at the time of the report 25 patients had been treated. Seven had been under observation less than four months and details concerning these are not included. In all of the remaining 18 cases the ulcers had healed without recurrence. Fifteen patients were unable to work at the time of the vagotomy, only one was still unable to work at the time of the report (nine months after operation). There were only two instances of vomiting after operation, pain and recurrent bouts of hemorrhage were relieved in all. Practically all of the patients gained weight, up to a maximum of 48 pounds with an average gain of 16 pounds. The average duration of symptoms prior to operation was eleven years.

X ray studies were done prior to and following operation and in no case where a crater was demonstrable before operation (8 cases) was it demonstrated after operation. The deformity at the site of the ulcer, however persisted. The four- to six hour retention increased remarkably after operation, and peristalsis of the stomach was described as "sluggish" in 8 cases as compared to one before. Special studies made following the introduction of a balloon into the stomach also showed a consistent decrease in the motility or peristaltic activity of the fasting stomach after vagotomy. The amount of secretion was consistently reduced and its acidity was markedly diminished in 11 patients and moderately so in 6 the latter number including those with the greatest delay in emptying the stomach.

The authors conclude as a result of their studies, that although vagotomy should block the neurogenic, psychogenic or reflex gastric secretory mechanism it may also have a broader effect and alter somewhat the endocrine or chemical secretory mechanism or facilitate neutralization of the free acid that it produces. The observations also indicate that while changes in secretion and acidity are important the most pronounced and consistent change produced by vagotomy is a decrease of the motility of the stomach. Since the decrease of acidity was least in patients who had the greatest obstruction by scar tissue and the greatest delay in emptying the stomach it seems probable that vagotomy should often be combined with pyloroplasty or gastrojejunostomy if the maximum benefit is to be obtained.

SYDNEY F THOMAS M D

omas and benign tumors other than polyps In the rectum, hemorrhoids, abscesses, and other anorectal conditions must always be considered in the differential diagnosis of malignant disease

Polyps are regarded as a definitely premalignant condition Because of this, their early recognition is of vital importance Radiographically they are best demonstrated by a contrast air enema [see following abstract] Actually they are demonstrable sigmoidoscopically in a large proportion of cases and, since they are usually symptomless until malignant change occurs, sigmoidoscopy is recommended as a part of every complete physical examination

The failings of the roentgen examination of the more distal portions of the colon and rectum are emphasized and re-emphasized, as they should be, especially as 70 per cent of malignant growths of the colon occur within the reach of a 10-inch sigmoidoscope

SYDNEY F THOMAS M D

Use of Double Contrast Enemas in Lesions of the Colon Magnus I Smedal S Clin North America 26 594-602, June 1946

Smedal points out the usefulness of air as a contrast medium in conjunction with barium, especially in dealing with polyps or polypoid lesions of the colon, where the amount of disturbance of the lumen is minimal In a previous review of 827 cases of cancer of the colon and rectum, 14 per cent were found to have arisen on the basis of a pre existing polyp (Swinton and Warren J A M A 113 1927, 1939) With a double contrast enema and stereoscopic views a much more complete picture of the colon is obtained than following the ordinary barium enema Preparation of the patient with castor oil is one of the prime necessities for an adequate double contrast examination The author also stresses the use of the after-evacuation air-contrast study as a valuable adjunct to the routine stereoscopic film with the bowel dilated with air

Diverticulitis with superimposed carcinoma can be differentiated quite frequently by the use of double contrast studies A film is reproduced in which the definitely irregular shelving margin characteristic of carcinoma is seen through the areas of narrowing due to the diverticulitis

[The author does not mention the use of a supine stereoscopic view for delineating more clearly the rectum and lower colon nor does he mention the use of oxygen instead of air to reduce the incidence of cramps especially in patients who have difficulty in retaining air]

SYDNEY F THOMAS M D

Interposition of the Colon Between the Liver and Diaphragm (the Chilaiditi Symptom) O Hubacher Schweiz med Wchnschr 76 554-559 June 22 1946

The author studied the incidence of interposition of the colon between the liver and diaphragm, first described by Demetrius Chilaiditi in 1910 In a series of 25,000 roentgen studies consisting of 20,000 serial fluoroscopic observations and 5,000 films, there were 22 examples of this abnormality, 0.088 per cent of the series This is a rather lower incidence than has usually been recorded The condition is believed to be congenital in origin The clinical symptoms are interesting They may consist of a subileus or a chronic constipation or in an elevation of the diaphragm leading to cardiac compression with abnormalities in the electro-

cardiogram These findings are rather rare, however, even when the abnormality is present A clinical diagnosis is rarely made, since it depends on percussion of the air in the colon and the air content is inconstant Several case histories are included

LEWIS G JACOBS, M D

Hepatodiaphragmatic Interposition of the Colon with Gastric Hypertrophy Case Report. Eli Starr Am J Roentgenol 56 22-26, July 1946

Hepatodiaphragmatic interposition of the colon has been reported by various observers to occur in about one per one thousand cases Usually it is discovered as an incidental finding It has been mistaken for free air under the diaphragm due to perforation of a hollow viscus The presence of haustral markings is a differential sign, especially helpful when the markings are seen in both erect and prone views The presence of a fluid level in the upright position would indicate that in addition to the meteoric hepatic flexure, there were free air and fluid in the right subphrenic space When clinical findings indicate laparotomy, interposition should not preclude surgical intervention

Constipation and flatulence are direct symptoms Indirect symptoms are dyspepsia, pyrosis, nausea, regurgitation, and vomiting The downward and left displacement of the liver compresses the pyloric end of the stomach and the first portion of the duodenum, producing gastric retention distention, eventual hypertrophy and possibly ulcerations It was believed by Bürger (Klin Wchnschr 4 102, 1925) and Weiland (München med Wchnschr 62 537, 1915) that perforated gastric ulcer is the primary disease, of which the interposition is a sequel

A case is reported of a young soldier who showed interposition on a routine chest examination Roentgenological examination of the stomach and duodenum showed extrinsic pressure upon the lesser curvatures of the stomach and duodenal cap Mucosal folds were hypertrophic and peristalsis was active This patient complained of constipation and bloating occasional heartburn, and gaseous eructation It was felt that the gastric enlargement and hypertrophy were due to hepatic pressure upon the stomach and duodenum

CLARENCE E WEAVER, M D

Some Observations on Radiology of the Pancreas R A Kemp Harper Proc Roy Soc Med 39 534-537, July 1946

Radiology has come to play an important part in the recognition of pancreatic disease One cannot emphasize too strongly the necessity for looking for evidence of such disease in all obscure cases with upper abdominal symptoms A routine barium meal study with full examination of the duodenum as well as the stomach, is the most satisfactory method of roentgen study, though gastric pneumography may be of assistance in selected cases as an additional aid

Calcification of the body of the pancreas is occasionally encountered and *calculi* have been reported in the ducts Six types of *cystic enlargement* have been described (Porta and Roversi) as follows

- 1 Cyst of the head—enlarging and flattening the duodenal loop and causing pressure deformity of the antrum

- 2 Cyst of the body—frequently displacing the stomach upward

anastomosis If this is not possible entero-anastomosis with exclusion or temporary enterostomy is advised for palliation. The operative mortality is about 20 per cent, and the duration of life following operation averages only 17.6 months. Nevertheless, the relief of obstruction and the comfort of the patient justify the surgical procedure.

The author's patient was a 53 year old white woman who two years before started losing weight. At the time she consulted the author she had lost 24 pounds. The symptoms began with indefinite abdominal distress unrelated to meals and unaffected by alkalies. After a year, there were attacks of excruciating abdominal pain radiating from the umbilicus to the left upper quadrant accompanied by nausea and vomiting.

Barium was given and a one hour examination showed a marked distention of the small bowel. The six hour examination showed the stomach to be empty and the small bowel markedly dilated to an area of deformity. A twenty four hour film showed the same findings. A diagnosis of an obstruction of the small bowel due to a neoplasm was made from the x ray films.

The obstructing lesion was removed together with a wedge shape piece of omentum. Pathological section showed adenocarcinoma of the small intestine affecting all coats. The patient was living seventeen months after the operation without evidence of recurrence.

JOSEPH T. DANZER, M.D.

Roentgen Diagnostic Methods for Detection of Colonic Lesions. Martin L. Tracey. S. Clin. North America 26: 603-605, June 1946.

The method of choice for determining the location and extent of colonic lesions above the sigmoid is roentgenography following a barium enema. The rectum and rectosigmoid seldom present positive findings except in large far advanced lesions. Therefore with (1) any change in bowel habits, (2) any unexplained rectal bleeding, and (3) anemia without visible bleeding a digital and proctosigmoidoscopic examination should precede the barium enema. It is wise even with visible anal lesions to rule out ulcerative inflammatory and neoplastic conditions in the upper colon.

The author does not feel that preparation is necessary since this may mask functional disturbances of the colon by promoting spasm and irritability, and since 'no greater number of lesions are overlooked by doing the barium enema without preparation than with preparation.' The experienced roentgenologist who visualizes a suspicious area may however wish to recheck it with preparation and an air contrast film. A suspicious area demonstrable both with and without preparation in the same location is excellent positive evidence. Preparation and air contrast studies are necessary for polyps and small lesions when suspected and undetected in the unprepared colon.

The mechanics of the examination of the colon are given in detail and those inexperienced in the roentgenoscopic examination of the colon should carefully read this section of the short article as it is quite lucid. The use of spot films with cone pressure is recommended as bringing out detail and recording more intracolonic lesions.

'To be noted in diagnosis of irritable colon are rate of flow, hesitation, and spasm, dilatation, extreme distress, absence of sensation of filling, tenderness confined to the colon, mass peristalsis and the amount of barium used (normal 1,000 to 1,500 c.c.)'

When severe distress or spasm follows introduction of the barium, it should be expelled and a second examination should be undertaken. Because of the antispasmodic effect of the initial barium a second attempt is likely to be successful.

For examination with a double contrast air enema preparation is essential. If castor oil or citrate of magnesia, 6-12 oz., is ineffective, a soapsuds or saline enema should be given an hour or two before the examination.

When the patient does not retain the double contrast enema some information may be obtained by observing the colon at three six and twenty four hours after a barium enema, or even with the aid of a barium meal followed by a saline cathartic. For the diagnosis of localized areas in the cecum and ascending colon a Miller-Abbott tube may be passed into the lower ileum and a small amount of dilute barium introduced to outline the area or a Rehfuess tube may be passed into the duodenum and a small intestinal barium enema given.

SYDNEY F. THOMAS, M.D.

Diagnosis of Carcinoma of the Colon and Rectum. Neil W. Swinton and J. Lawrence Gillespie. S. Clin. North America 26: 553-563, June 1946.

Swinton and Gillespie point out that in no other field of surgery has such gratifying progress been made as in the field of surgery of the colon and rectum. The resectability rate in the Lahey Clinic from which this report comes is now 85 per cent and the five year survival rate 50 per cent. Unfortunately there has been little or no change in the interval between the onset of symptoms and the establishment of the diagnosis of cancer. In order that this may be reduced the following recommendations are made:

1. Increasing attention must be paid to symptomatology.

2. The differential diagnosis from non malignant lesions must be appreciated.

3. The indications for digital examination of the rectum, sigmoidoscopic study of the rectum and lower sigmoid barium enema, and air contrast radiography of the rectum and colon must be understood.

4. A constant search for and the removal of premalignant lesions must be undertaken.

5. An accurate diagnosis of cancer must be made at the earliest possible time.

The authors divide the symptomatology on the basis of lesions arising in the right colon and the left colon. The lumen of the bowel on the right side is considerably larger than on the left and obstructive signs therefore appear late in right colonic lesions but early when the left side is involved. Lesions of the right colon are accompanied by anemia in a high percentage of cases, pain is also a prominent symptom but a palpable tumor is present in only a few cases. Abnormalities of the stool constitute the chief symptom of rectal carcinoma and demand scrupulous examination. They include the presence of blood, pus or mucus as well as any change in caliber of the stool.

In view of the fact that 70 per cent of surgical procedures on the large bowel in the Lahey Clinic are for malignant tumors the authors consider it justifiable to regard any unproved lesion of the colon as cancer until some other diagnosis is established. Among the lesions to be considered in the differential diagnosis are chronic stenosing regional enteritis, diverticulosis and diverticulitis, tuberculosis of the ileocecal region, benign polyps, volvulus, sarcoma, non specific granu-

In the differential diagnosis, scurvy was eliminated because of the lack of roentgen evidence at the ends of the long bones absence of subperiosteal hemorrhage, and failure of response to massive vitamin C therapy checked with ascorbic acid blood level determinations Syphilis and tuberculosis were ruled out by non-contributory family histories, biopsy findings, and repeatedly negative serologic and tuberculin tests Non-specific infection was considered because of the fever, leukocytosis and concurrent upper respiratory disease However response to sulfa therapy was poor, the distribution of the bone lesions was widespread, suggesting a metabolic rather than a local disease, and no pathogenic organism was recovered by culture of material from the nose, throat, urine blood, or biopsy It is admitted that no virus studies were made Traumatic periostitis and pulmonary osteoarthropathy are discussed, but these possibilities appear remote

The course of the disease was protracted for several months, but complete recovery occurred in each case.

Reports of atypical scurvy and of unusual periostitis were culled from the literature and are discussed by the authors, who consider them to be examples of the syndrome presented above

LESTER M J FREEDMAN, M D

Multiple Myeloma Simulating Hyperparathyroidism. Dorothy Gill Ann Int Med 24 1087-1093, June 1946

The appearance of a high blood calcium in such conditions as multiple myeloma and metastatic carcinoma of bone has led to speculation as to whether this is simply incident to diseases causing rapid bone destruction or whether true hyperactivity of the parathyroid glands exists The author's case of multiple myeloma is of interest since the parathyroid glands were grossly and histologically normal, though a marked hypercalcemia was present

Roentgen rays of almost the entire skeleton were taken and showed various extensive areas of destruction involving the pelvis lumbar spine, humerus femurs ribs, clavicles, and skull Many of the lesions were punched out in type Other areas were diffusely decalcified with good trabeculation Various selected rib lesions were exactly like those of metastatic carcinoma, while others in the long bones resembled those of multiple myeloma The consensus of radiological opinion, however was in favor of osteitis fibrosa cystica

A diagnosis of hyperparathyroidism having been made, the patient a 38-year-old housewife, was submitted to exploration of the neck Two inferior parathyroid glands were located and a subtotal resection of the right plus a total resection of the left was performed These proved on histological examination to be of normal structure The superior parathyroids were not demonstrated A bone marrow biopsy was then be-latedly performed and yielded a red gelatinous material which showed 72 per cent typical myeloma cells Autopsy showed extensive replacement of bone marrow with myeloma cells No further parathyroid tissue was found

The clinical and laboratory findings common to both multiple myeloma and hyperparathyroidism which were present in this case were as follows progressive weakness and anemia bone pain abdominal pain, vomiting bone cysts and pathological fractures demonstrable by roentgen ray and high blood calcium Findings frequently present in multiple myeloma but absent here,

were Bence-Jones proteinuria, elevated total serum proteins, reversed albumin-globulin ratio, and evidence of kidney insufficiency Findings frequently present in hyperparathyroidism, but absent or doubtful here, were a low blood phosphorus, a negative calcium balance (high urinary calcium excretion), and increased blood phosphatase In this case, one blood phosphorus determination was definitely low (2.22), the others low normal Only postoperatively did the phosphatase level rise above normal A history of kidney stones in the past was quite suggestive of hyperparathyroidism

If pitfalls in diagnosis are to be avoided where much overlapping of clinical and laboratory findings occurs and where hypercalcemia is the only constant feature, it is obvious that all possible diagnostic procedures should be undertaken at the outset

STEPHEN N TAGER, M D

Critical Study of Chronic Vertebral Rheumatism A. P Lachapèle J de radiol et d'électrol 27 285-312, 1946

The author considers the growth of various concepts of vertebral arthritis and goes on to a discussion of the different types under the names that have come into common usage

Rhizomelic Spondylitis This is the form usually referred to as Marie Strümpell arthritis, and the cardinal diagnostic point is ligamentous ossification along the spine producing the so-called "bamboo spine" Other concomitants have been pointed out by various authors and deleted by others It often seems a part of the entity known as rheumatoid arthritis though in some instances it lacks most of the febrile manifestations of this type Early closure of the inferior borders of the sacroiliacs is often mentioned [Oppenheimer has called attention to the fact that ligamentous ossification may occur in connection with several distinct disease entities, so that it does not deserve classification as an entity in itself]

Chronic Osteophytic Rheumatism This is ordinary osteoarthritis, though the author's description is involved and the meaning not too clearly brought out.

Traumatic Spondylitis This designation the author confines to what has been called Kummell's disease [This so-called entity is now, I believe, generally recognized by orthopedic surgeons as an overlooked compression fracture]

Spondylarthritis Due to Known or Unknown Organisms This group includes osteomyelitis typhoid spine, arthritis of undulant fever, meningitic arthritis, that due to typhus gonococcus, pneumococcus, etc

Poorly Classified Chronic Arthritides Indistinct entities, osteoporosis of the spine, the facet syndrome and others the author does not consider are well enough established to be given an unquestioned place in his classification

The author's first illustration (anteroposterior view) will call forth contradictory opinions It is one in which two lumbar vertebrae are bridged along the sides and which is typically an osteoarthritis This change he attributes to pneumonia

Another case in which a vertebra gradually narrowed until only a wedge was left (the disk above and below not appearing to be involved) suggests very strongly a compression fracture in an osteoporotic spine with some possibility of a metastatic lesion The author designates this one as due to "grippe"

All the rest of the illustrations fit quite easily into our

3 Cyst of the tail—displacing the greater curvature medially and the transverse colon downward and laterally

4 Gastrohepatic type which displaces the lesser curvature downward and often the third part of the duodenum and transverse colon also

5 Gastrocolic type, displacing the stomach medially and the transverse colon distally

6 Mesocolic type, displacing the stomach and transverse colon proximally

Carcinoma occurs most frequently in the head of the pancreas. Its diagnosis depends on the deformity produced and infiltration of the stomach and duodenum. When the lesion is situated in the region of the ampulla it may produce the reversed 3 sign described by Frostberg (Acta radiol 19 164 1938 Abst. in Radiology 32 381 1939) but this occurs in a fairly small proportion of cases of carcinoma and may be present in other types of pancreatic enlargement. Widening of the duodenal loop and a pressure effect are insufficient evidence on which to base a diagnosis of carcinoma, although frequently they constitute the only radiological signs for a long time. The additional factor of erosion or invasion of the duodenal wall or stomach must be observed before making the final diagnosis. Occasionally enlargement occurs high up in the head of the pancreas and produces a fairly characteristic sickle-like appearance of the duodenum. With invasion of the antrum of the stomach difficulty in differentiation from a gastric carcinoma may be considerable unless enlargement of the head of the pancreas is marked.

Chronic pancreatitis produces enlargement of the gland without duodenal or gastric invasion. Radiological differentiation from carcinoma may be difficult.

Enlargement of the prepancreatic lymph nodes secondary to gastro intestinal cancer or due to Hodgkin's disease or lymphosarcoma must be differentiated from intrinsic disease of the pancreas as must retroperitoneal sarcoma. SIDNEY F THOMAS, M D

Aberrant Pancreas. Arthur J Present Am J Roentgenol 56 55-57 July 1946

Aberrant pancreatic tissue in the gastro-intestinal tract is of sufficient frequency to warrant its consideration in the differential diagnosis of so-called 'filling defects' noted in barium studies. Most of the nodules are small and symptomless. Cases have been reported however in which the ectopic tissue caused or was associated with obstruction and intussusception. Pancreatitis malignant change or proliferation of islet tissue producing hyperinsulinism may also occur. The most frequent site is the stomach or duodenum.

Two cases are reported. In one there was a large intramural tumor of the gastric antrum. The patient complained of loss of weight intermittent nausea vomiting and hematemesis. There was delay in gastric emptying. The second case presented the fairly typical elements of a polyp and probably produced no symptoms. In neither instance was the true nature of the condition recognized preoperatively. CLARENCE E WEAVER M D

THE MUSCULOSKELETAL SYSTEM

Radiological Aspects of Various Forms of Dwarfism. Giulio de Guili and Leonardo Ducci Riv di clin pediat (Firenze) 44 321-352, July 1946

The authors analyze the different definitions of dwarfism which have been given by Lecomte, Roessle,

Bochardt, and Schinz, and attempt to differentiate various forms of the condition according to the radiological appearance. Their presentation is based upon the study of 10 cases including instances of osteomalacia, rickets, osteogenesis imperfecta, achondroplasia, hypophyseal deficiency with Cushing syndrome, hypothyroid dwarfism with myxedema, premature closure of epiphyses and sexual disturbances.

Radiological examination has been found to allow the division of cases of dwarfism into three groups: (1) cases in which the bone growth is retarded (essential dwarfism, endocrine dwarfism), (2) cases in which one finds actual alteration of the epiphyseal cartilages (achondroplasia, rickets, chondrodysplasia), (3) cases in which there are no alterations of the chondral ossifications (osteomalacia and fragilitas ossium).

The inclusion of osteomalacia and of fragilitas ossium in dwarfism is rather confusing because the short stature of the patients is due to bowing or fractures of the long bones and not to true shortening. This inclusion, however, may be useful from a clinical standpoint. CESARE GIANTURCO, M D

Periosteal Reaction, Fever and Irritability in Young Infants: A New Syndrome? Francis Scott Smyth, Alice Potter, and William Silverman. Am J Dis Child 71 333-350 April 1946

A new syndrome in infants and young children is suggested by the authors, characterized by secondary anemia, leukocytosis, low fever, irritability, and periostitis of the flat and long bones of several months duration.

Seven cases are presented: 5 in boys and 2 in girls, the ages ranging from three months to two and a half years. Symptoms were present one to several months prior to admission. All of the 5 young infants had swelling or brawny induration of the face and were markedly irritable when touched or handled. Four of these infants showed periosteal new bone formation of the mandible and one of the two older children showed similar changes of the nasal bones roentgenologically. Other bones commonly involved included the clavicles, ribs and long bones of the extremities. Except in one instance the roentgen findings were marked and show clearly on the reproductions although the general quality of the latter is only fair. The findings varied from simple elevation of the periosteum and onion-skin lamination to a massive sclerosis.

Physical examination revealed tender swelling or induration over the bone lesions although in several instances swelling was present without roentgen abnormality in the underlying bone. Three patients had a concurrent mild upper respiratory infection with a questionable otitis media suspected in one case. Incidentally a provisional diagnosis of otitis media was made in several of the infants prompted by the fever and tender facial swelling. This diagnosis was altered when no change in status occurred during or following sulfonamide therapy.

Diagnostic studies failed to identify this syndrome with any known disease entity. Biopsy showed fibrosis, degeneration and atrophy of skeletal muscle. Bone biopsy in one case showed an irregular proliferating cartilage line with irregular cell clumps instead of the usual cell columns, periosteal new bone formation and increase of fibrous tissue in the marrow. The findings were considered similar to those in osteitis fibrosa and muscular dystrophy.

union was strong enough to prevent movement between the bodies but the zygapophyseal joints did show motion

Where union of the two vertebrae occurred, the total length of the fused bodies was less than before removal of the disk and there was a tendency toward dorsal buckling at the site of union

The process of union between the vertebral bodies is similar to the process of union in fractures

JOHN B MCANENY, M D

Bilateral Recurrent Intercarpal Subluxation
Charles J Sutro Am J Surg 72 110-113, July 1946

The author presents 2 rather unusual cases of painful wrists which were found to be due to recurrent dislocation of some of the carpal bones in relation to the others. The subluxations occurred only with movements of the wrist and were bilateral and not connected with trauma but were definitely associated with a clicking sound and were followed by swelling due to joint effusion after the motions had been repeatedly carried out. The subluxations demonstrated by both films and fluoroscopy, in one instance involved the capitate bones which dislocated anteriorly, and in the other consisted of an anterior subluxation of the entire distal row of carpal bones and their adjacent metacarpals with respect to the proximal row of carpal bones. The first case was treated by surgical arthrodesis and a very satisfactory result was achieved. Therapy in the other case is not reported.

The author's hypothesis is that the condition is brought about by excessive length of the ligaments binding the carpal bones and an imbalance of power between the flexor and extensor apparatus of the fingers and hand

PAUL W EYLER, M D

Some Observations on the Fractured Carpal Scaphoid
John J Bedrick and Sigmund A Zawadzki
Mid Surgeon 98 488-491, June 1946

This is a study of 31 carpal scaphoid fractures seen in a military hospital during a thirty six months' period. Roentgenograms were taken in the anteroposterior, lateral and oblique positions with the hand in ulnar deviation and comparative studies of the other wrist were made in doubtful cases. If clinical signs were severe even when roentgenograms were negative the injury was treated as a fracture and roentgen examination was repeated in ten days. Nineteen of the 31 scaphoid fractures were fresh. 18 of these went on to bony union following simple immobilization for periods of twelve to sixteen weeks while in the nineteenth case there was non union and operative intervention was necessary. The remaining 12 cases were old ununited fractures which had been missed for periods ranging from six to eighteen months, all required operative intervention.

Eosinophilic Granuloma of Bone Report of a Case Involving the Clavicle R Beverly Ray and Aaron Kellner J Bone & Joint Surg 28 629-634 July 1946

Eosinophilic granuloma of the clavicle has been reported previously but its occurrence is rare enough to warrant presenting a single case. A 22 year-old soldier complained of pain tenderness and swelling at the proximal end of the left clavicle. Four weeks later, a roentgenogram showed a destructive lesion at the sternal end of the left clavicle thought to be an acute osteomyelitis. The patient was transferred to another

hospital and further study suggested a new growth with a soft tissue mass, possibly malignant. Biopsy of the lesion showed eosinophilic granuloma.

Eosinophilic granuloma may simulate almost any bone lesion, inflammatory or neoplastic. The solitary lesions may suggest a cyst, giant-cell tumor, or Ewing's tumor. If the lesions are multiple, one must consider multiple myeloma, lymphoma, metastasis, and neuroblastoma. There is no characteristic appearance of eosinophilic granuloma of bone.

JOHN B MCANENY, M D

Osteochondromatosis of the Elbow R J Dittrich
Am J Surg 72 125-127, July 1946

A brief discussion of the etiology, pathology, and clinical features precedes a case report of osteochondromatosis of the elbow. The etiology is recognized as obscure. Osteocartilaginous bodies vary greatly in size, number, and location and are derived from synovial tissue. They may either be attached to the synovia or free within the joint. Clinically the patients usually complain of arthritic pains in the joints. Loose bodies may be palpated within the joint and roentgenography confirms their presence.

This case report is noteworthy because symptoms developed only two days after injury. X rays and operation showed three loose osteocartilaginous bodies, almost 1 cm in diameter in the elbow joint.

VERN W RITTER, M D

Air Arthrography as an Aid to Diagnosis of Lesions of the Menisci of the Knee Joint. E W Sommerville
J Bone & Joint Surg 28 451-465, July 1946

The basis of this study is 331 knees examined by air arthrography. The procedure consists in preparing the skin as for operation, forty eight hours before the arthrography, and wrapping the area in sterile towels. Under pentothal sodium anesthesia, filtered air is injected into the joint and the films are obtained.

The knee is placed over a curved cassette and the following tangential views are taken. Anteroposterior, anteromedial and posteromedial of the medial meniscus, anteroposterior, anterolateral and posterolateral of the lateral meniscus, a mediolateral and a lateromedial of the posterior aspect of the joint. An additional supero inferior view of the patella on an occlusal film is sometimes made to demonstrate the articular surfaces of the patella and adjacent condylar articular surface. These various views give adequate definition of all of both menisci. The presence of the shadow of the popliteus is noted and its outline described.

Numerous beautiful reproductions of the various views of the knee, both normal and abnormal, are presented.

The author finds his accuracy in diagnosis rapidly improving with experience in the procedure.

JOHN B MCANENY, M D

Discol Cartilage of Knee Stuart A Thomson
Canad M A J 54 596-598 June 1946

Of 16 patients operated upon in the past twenty years for internal derangement of the knee, only 5, ranging from five to thirteen years of age were found to have a disk shaped anomaly of the external cartilage, in one case the anomaly was bilateral.

Common persistent complaints are a "snapping sensation" on active movement and difficulty in walking.

classifications of Marie-Strümpell arthritis, or osteo arthritis, or of another group very aptly named though not yet very widely recognized, as 'disco-netic' Another group, suggested once or twice in the series has been grouped for some time by orthopedic surgeons as 'hyperextension injury'

PERCY J DELANO M D

Myelography in Patients with Ruptured Cervical Intervertebral Discs Francis Murphy, Lucien M Pascucci William H Mead and Benjamin R Van Zwailenburg *Am J Roentgenol* 56 27-42, July 1946

Recently it has been established that lateral rupture of the cervical intervertebral disks producing pain in the neck, shoulder, and arm is a fairly common lesion. The authors' experience is based on 62 cervical myelograms 28 per cent of which were positive with 16 verified at operation. Lateral herniation may result from slight or severe trauma or it may appear without any recognizable injury. These lesions have been classified into two types: (1) the soft extruded nodule of nucleus pulposus which may later undergo degeneration and calcification and when calcified is often wrongly interpreted as an arthritic spur, (2) protrusions of the disk without rupture of the annulus fibrosus or extrusion of the nucleus.

For myelography, 6 c.c. of pantopaque is injected between the fifth lumbar and first sacral segments, and under roentgenoscopic control this is allowed to flow into the cervical region. Exposures are made in frontal and oblique positions. The opaque material is removed from the lumbar area after the examination is completed.

The authors stress the importance of a preliminary plain film examination. The following abnormalities are to be looked for in the plain roentgenograms: (a) scoliosis, (b) straightening or reversal of the normal cervical curve, (c) calcification in the posterior joint space, (d) encroachment on the intervertebral foramen by a soft tissue shadow and/or osteophyte, (e) localized arthrosis. It is believed that a significant number of cases of arthrosis are a result of injury to the disk rather than due to degenerative arthrosis.

Although preliminary examination gives adequate information about the intervertebral joint space, the myelogram from a roentgenologic standpoint is in most cases necessary for demonstrating protrusion or herniation of the nucleus pulposus. Four types of lesions were seen most commonly in the myelograms in the authors' series: (1) The shallow 'half moon' defect with an irregular or smooth base; the nerve root may be broadened or obliterated. (2) The triangular defect with a clear-cut lower border and less distinct upper border. (3) The poorly circumscribed 'pressure' defect due to compression of the spinal cord with obliteration of the nerve root. (4) The large irregular gap defect, sometimes extending to the midline.

A high degree of accuracy in roentgen diagnosis was possible only by correlating the clinical and myelographic findings. It seems justifiable to conclude from the evidence thus far obtained that the negative cervical myelogram bears more weight than the negative lumbar myelogram. Positive cervical myelographic findings have proved highly accurate in the authors' series of operated cases. In many cases the diagnosis can be made on the basis of the clinical findings.

CLARENCE E WEAVER M D

Prespondylolisthesis: A Study of Twenty-Three Cases Paul E McMaster and Fred M Dula *U S Nav M Bull* 46 1077-1082, July 1946

Twenty-three cases of symptomatic prespondylolisthesis, occurring in a group of 350 consecutive patients with low back pain seen during a seven month period are discussed. In the same group were 6 cases of spondylolisthesis, thus indicating a preponderance of almost four to one of the so-called 'pre-slipping stage' over the stage of actual slipping. All patients were males in the military service. Nine dated the onset of symptoms from an injury while the others stated that the back pain developed gradually without primary trauma. Physical examination showed moderate to fairly marked lumbar muscle spasm and corresponding limitation of spinal motion, especially flexion and extension in all but 5 cases. Tenderness to percussion at the lumbosacral area was present in all. The diagnosis of 'prespondylolisthesis' was established roentgenologically with the demonstration of a defect in the neural arch between the superior and inferior articular processes. In all suspected cases multiple views were taken in various planes—anteroposterior, lateral and right and left oblique. The fifth lumbar was involved in 12 cases, the fourth in 2, a lumbarized first sacral segment in 7, and a combination of the fourth and fifth lumbar in 2. In 17 cases the defect was bilateral. In none of the 23 patients was there definite evidence of a herniation of the nucleus pulposus such as roentgen demonstration of a narrowed disk or lower extremity motor reflex or sensory change.

Spondylolysis and Its Relation to Spondylolisthesis M P Rhodes and C Colangelo *Am J Surg* 72 20-25, July 1946

Spondylolysis literally means dissolution of all or part of a vertebra, but through common usage it has become synonymous with defects in the neural arch. This condition is present in all cases of spondylolisthesis but may occur without actual 'slip' of the vertebral body. Roentgen examination in the lateral and oblique positions is pointed out as the only reliable method of diagnosis of spondylolysis. Attention is directed to the necessity of distinguishing the defect from fracture of the isthmus and from accessory ossicles of the inferior articular processes. Conditions which are clinically similar to but roentgenologically different from spondylolysis are subluxation of the apophyses, arthritis of the apophyses, and various forms of disk disorders. The authors caution against overreading studies of the low back lest pathologic significance be ascribed to insignificant variations in a region where the normal appearance is of such wide variability. They examined 1,250 low backs and in this group found 60 cases of spondylolysis, 34 of which were complicated by the coexistence of spondylolisthesis. 26 of these 34 cases showed first-degree displacement. The usual clinical findings and methods of therapy are discussed.

PAUL W EYLER M D

Fusion of Vertebrae Following Resection of the Intervertebral Disc S L Haas *J Bone & Joint Surg* 28 544-549, July 1946

An intervertebral disk in the lumbar region was removed from each of six dogs of various ages and the operative site was re-examined after 120 to 146 days. In all but one instance complete bony fusion developed between the bodies. In the exceptional case fibrous

fully removed. Roentgenography showed a huge tumor filling the right half and upper and middle portions of the left half of the abdomen, and displacing stomach and intestinal tract. Retrograde pyelography showed the right renal pelvis to be displaced far into the left upper quadrant of the abdomen, so that it lay farther to the left than the left pelvis.

JOSEPH P. TONSULA, M.D.

Benign Papilloma of the Ureter. Ernest Felber. J. M. A. Georgia 35: 200-202, July 1946.

Tumors of the ureter are rare, especially benign tumors. They produce no characteristic symptoms. If the tumor can be seen cystoscopically protruding from the ureteral orifice into the bladder, the diagnosis is easy, otherwise it rests upon the demonstration of a filling defect in the ureter by ureterography.

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BERNARD S. KALAYJIAN, M.D.

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F sound passed easily through the normal (ventral) urethra, an 18 F could be manipulated only to the region of the prostate in the dorsal (accessory) urethra. There was no metallic contact between the two sounds.

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ALTON S. HANSEN, M.D.

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SYDNEY F. THOMAS, M.D.

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on rough ground or downstairs. A variably palpable tender mass along the lateral joint line anterior to the collateral ligament, an increase of medial joint play due to stretching of the external collateral ligament, and atrophy of the quadriceps, may be found. X-ray examination usually reveals widening of the lateral joint space.

Operative removal appears to give a satisfactory cure.

WILLIAM P. MARTIN, M.D.

A Case Resembling Hemangiomatosis of the Lower Extremity. David J. King. *J. Bone & Joint Surg.* 28: 623-628, July 1946.

An 11-year-old boy injured his knee in April 1941. A roentgenogram shortly afterward showed no bone change, nor was any change demonstrable on a second examination in July, although there was swelling and discoloration of the skin. In February 1942, while turning in bed, the patient experienced pain for the first time, and swelling of the thigh and upper leg developed. Roentgenograms at this time showed a pathological fracture and decalcification of bone. The only other abnormal laboratory finding was a blood phosphatase of 18.2 Bodansky units.

In May 1942 the extremity was amputated at mid thigh. Examination of the tissue showed many thin-walled vessels resembling hemangioma. In February 1943 the remainder of the femur showed decalcification, with numerous punched out areas here and in the adjoining portion of the pelvis. Biopsy yielded the same kind of tissue as in the amputated extremity. At this time roentgen therapy was given—200 kv., 50 cm. distance, h.v.l. 1.05 mm. Cu. for a total of 1,700 r to each of four ports. In July 1944, recalcification was occurring satisfactorily and the quality of the bone was more nearly normal.

JOHN B. McANENY, M.D.

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography with Visco-Rayopake. Preliminary Report. Jacob Warren. *West J. Surg.* 54: 294-299, July 1946.

Viscorayopake is an aqueous solution of an organic iodide containing contrast salt (diethanolamine salt of 2,4-dioxo-3-iodo-6-methyl-tetrahydro-pyridine acetic acid) together with 3.5 per cent polyvinyl alcohol. It is the latter compound which imparts to the preparation its characteristic viscosity. This new radiopaque medium, unlike the older oil preparations, is absorbed within a few hours after injection. This property obviously makes a twenty-four hour check impossible but it obviates the dangers of tubal occlusion by inspissated particles and later by foreign body granulomas.

Rubin in his original publication on this substance (*M. Rec.* 152: 212, 1940) pointed out that an ideal contrast medium for gynecological use should have three qualities: satisfactory radiopacity, adequate viscosity and rapid resorbability, all of which requirements are met by viscorayopake. The toxicity of the material has been worked out in the Department of Pharmacology of Georgetown University by Koppony and confirmed by Rubin. It is said that the amount usually employed for uterosalpingography contains less than one-fiftieth of the maximum tolerance dose of the contrast acid and less than one-five-hundredth of the tolerance dose of polyvinyl alcohol.

The technique for hysterosalpingography with the new

contrast medium is described in some detail. It differs in no important respect from the usual iodized oil technique.

Four illustrative cases are presented in the body of the article and a report of a case of uterus didelphys demonstrated by viscorayopake is appended.

The author has had no untoward reaction of a toxic or allergic nature in his experience with this medium.

SYDNEY F. THOMAS, M.D.

A Note on the Amount of Radiation Incident in the Depths of the Pelvis During Radiological Pelvimetry. J. H. Martin and E. Rohan Williams. *Brit. J. Radiol.* 19: 297-298, July 1946.

Determinations of the amount of radiation received in the depths of the pelvis during radiological pelvimetry were made in two women, one fourteen weeks and the other thirty-seven weeks pregnant, by placing a thimble chamber as high in the vaginal vault as possible. Four films were made on each patient, an antero-posterior, superior-inferior, lateral and subpubic arch projection. In neither patient was the dose measured as much as 0.9 r.

SYDNEY J. HAWLEY, M.D.

THE GENITO-URINARY SYSTEM

Massive Perirenal Lipoma with Report of a Case. George E. Pfeiffer and Morris M. Gandin. *J. Urol.* 56: 12-27, July 1946.

The authors in adding one case of perirenal lipoma to the 200 and some odd cases of this relatively rare condition previously recorded, present an excellent concise historical background. The condition is more common in females and is seen most frequently between the ages of forty and sixty, though a case in an infant of fifteen days has been recorded. Of all reported cases, it is estimated that approximately 37 per cent are of perirenal origin. The remainder arise from the fatty renal capsule.

Pathologically the tumor contains fatty and fibrous tissues in varying proportions, the grossly mixed type being the most prevalent. Histologically the origin may be from the mesentery, omentum or the immediate perirenal tissues. Some of these tumors have weighed over 50 pounds.

Symptoms are vague and secondary to the compression changes produced by a slowly enlarging tumor which displaces abdominal and thoracic viscera. The prognosis is regarded as grave, owing to the frequency of recurrence and a tendency to sarcomatous change. The present day operative mortality is 20 per cent. Uninhibited these tumors produce cachexia and death.

Radiologically it is of importance to know that this tumor does occur. Recognition of the growth can be made from the presence of an intra-abdominal mass of varied size which compresses abdominal viscera changing normal relationships in the process and altering physiologic function with elevation of the diaphragmatic leaves either unilaterally or bilaterally. Retrograde pyelographic studies show the usually marked displacement of the involved kidney. Renal calculi can frequently be found in association with the growth. Function of the affected kidney is usually greatly impaired or destroyed. The differential diagnosis must consider ovarian cyst, other abdominal tumors, ascites, pancreatic cyst, cirrhosis and pregnancy.

The authors' patient was a 49-year-old male from whom a fibrolipoma weighing 26½ pounds was success-

fully removed. Roentgenography showed a huge tumor filling the right half and upper and middle portions of the left half of the abdomen, and displacing stomach and intestinal tract. Retrograde pyelography showed the right renal pelvis to be displaced far into the left upper quadrant of the abdomen, so that it lay farther to the left than the left pelvis.

JOSEPH P. TOMSULA, M.D.

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The technic employed at the University of California Hospital is described. The needles are placed symmetrically in the veins of each foot while the patient is still on the ward. Usually a vein on the dorsum is cannulated by direct puncture, and the lumen is kept open by having saline drip through the needles slowly. A blood pressure cuff is placed around each ankle. The patient is placed supine on the x-ray table, with a 14 X 17-inch film tunnel beneath the leg and another beneath the thigh. Stationary grids are fastened to the surface of each tunnel. The tube is used at a distance of 63 in. A rectangular lead diaphragm is used on the tube so that the beam just covers the films. In the cassettes under the legs a piece of black paper covers one of the screens. After a preliminary exposure the blood pressure cuffs are inflated to 20 mm Hg pressure and 20 cc of 70 per cent diodrast is injected through each needle at the same rate. The time for injection is about one minute. The first film is taken at 30 seconds, the tube is shifted sideways 6 inches and a second pair of films is taken at one minute, the tube is then returned to the original position and a third pair of films is taken at a minute and a half. If there is reason to suppose that the circulation is very slow, a fourth pair may be taken after another half minute.

The author quotes Baker's analysis of the venous patterns in acute and chronic deep and superficial blocks (*Radiology* 43:129, 1944). In acute superficial venous blocks with no involvement of the deep veins excellent visualization of the deep venous system is obtained and the superficial veins are straight and of even caliber up to the point of the block. In chronic superficial blocks the veins are tortuous and dilated. In acute deep blocks there is absence of filling of the deep vessels or partial filling which may actually demonstrate the thrombus. Frequent anastomoses of the superficial veins are seen. In chronic deep venous block no deep veins are seen and the superficial veins are dilated and tortuous. MAURICE D. SACHS, M.D.

Experimental Study of the Vertebral Venous System—Preliminary Report. A. S. Johnstone. *Proc Roy Soc Med* 39:538-540, July 1946.

The author describes in some detail the work of Batson (*Ann Surg* 112:138, 1940) who demonstrated a vertebral venous system which he considered to be independent and quite distinct from the caval pulmonary and portal systems. This was said to consist of

complex interlacing tributaries running along the spinal canal in and around the vertebral bodies, with few valves, very little permanent flow, and low pressure. Batson demonstrated this system in cadavers by the injection of vermilion water color into the deep dorsal vein of the penis. The distribution of the medium in and around the sacrum, lumbar spine and ilia as demonstrated radiologically, was quite comparable to the distribution of metastases in cancer of the prostate and led Batson to dismiss the old work of Handley and Willis on the possible routes of metastatic spread. Batson further contended that the free communication of the bronchial veins with the plexus around the spine clearly explained the intracranial spread of metastases from bronchial cancer and lung abscess. In a similar way he explained the source of the air embolism following pneumothorax.

The author tried to confirm Batson's findings and presents some roentgenograms showing his results. He used various media (he was unable to obtain vermilion water color) and in some instances injected cadavers soon after death, obtaining roentgenograms immediately and again after a lapse of twelve hours. Comparison of the two sets of films showed less medium in the caval system and more around the vertebrae in the later ones, suggesting that the force of gravity may play a role. In all the experiments there was evidence that the main return took place through the caval tributaries. It is concluded that the principal venous drainage from the prostatic plexus flows into the caval system regardless of the viscosity of the medium used. "It would appear," says the author, "that Batson has tried to establish the existence of a route of metastatic spread principally on the fact that the radiographs of injected pelvic and vertebral veins bear a resemblance to the radiographs of carcinomatous deposits in these bones. If his conclusions are correct it is difficult to explain the relative absence of metastases in the transverse and spinous processes if there is such free communication between the veins." It is further pointed out that, although the bone marrow may have no lymphatics, the perineural lymphatics provide adequate channels for cells to reach the periosteum and cortical bone.

[Batson's work was also repeated by Norgore (*Surgery* 17:608, 1945; *Abst in Radiology* 46:204, 1946) who believed it offered an anatomic explanation for so-called paradoxical metastases.—Ed.]

SYDNEY F. THOMAS, M.D.

RADIOTHERAPY

Low-Voltage, Short-Distance Roentgen Therapy (Contact Therapy) in Dermatology. Paul Cottenot and René Bourdon. *J de radiol et d'électrol* 27:319-332, 1946.

In general the factors employed by the authors for contact irradiation of dermatological conditions are 80 kv, 5-8 ma, 0.1 mm Cu filter, 1-7 cm distance. In some cases special apparatus is required for intracavitary radiation. The illustrations accompanying the paper show the sort of epitheliomas of the face which are most commonly met with in the average hospital. Some are in difficult situations as in the inner canthus of the eye, others are on the lip.

One point must be noted and that is regarding the amount of radiation. The total amount given generally in about six treatments runs from 8,000 to 15,000

r (one case received 20,000 r, one senile keratosis received 4,000 r). This is considerably in excess of the amounts employed by most American radiologists, particularly those of us who have felt that we could standardize our procedures quite satisfactorily along the lines laid down by Widmann a few years ago. The results shown here, though good, are no better than we have been used to seeing with a half or a third of the dose employed by these French authors.

PERCY J. DELANO, M.D.

Roentgen Therapy of Pituitary Adenomas. Joseph A. Mufson and Samuel S. Blankstein. *Wisconsin M J* 45:680-685, July 1946.

The purpose of this report is to strengthen the argument for radiotherapy as the initial treatment of choice

in pituitary adenomas and to condemn routine surgical intervention in all cases. The authors briefly review the pathologic and clinical considerations in the three types of adenomas. Three cases, all of the chromophobe type, are reported, in which the only form of treatment was radiotherapy. In all headache disappeared early and there was moderate to marked improvement in the visual acuity and perimetric visual fields.

Since in the average neurosurgical clinics the mortality rate for surgically treated pituitary adenomas is from 10 to 15 per cent, and since at least 50 per cent of the chromophobe adenomas and most of the eosinophilic adenomas show good results with x-ray therapy alone, it seems logical that the least hazardous form of therapy be tried first and surgical decompression be limited to those patients who fail to respond to irradiation. If in spite of a complete course of roentgen therapy the visual fields and acuity continue to diminish, surgical decompression of the optic chiasm is indicated with postoperative irradiation.

RUSSELL WIGH, M D

Radiotherapy in Ophthalmology Duncan Macdiarmid. New Zealand M J 45 224-229, June 1946.
X-Ray Treatment in Ophthalmology Bruce Mackenzie. Ibid pp 230-231.

Macdiarmid presents a series of corneal lesions and malignant lesions of the lid treated by radiotherapy, by Dr Mackenzie, after they had failed to respond to other methods of treatment. Of 15 corneal lesions, 8 showed permanent improvement, and 5 temporary improvement, two cases of metaherpetic keratitis were made worse by irradiation. Four cases of rodent ulcer of the lids were successfully treated by excision and radiotherapy and one case by radiotherapy alone. One case of epithelioma of the lower lid was treated by radiotherapy following excision.

Mackenzie treated 46 cases of basal cell or squamous-cell carcinoma of the eyelids with roentgen rays with only one failure. For superficial basal or squamous epitheliomata of the eyelids three treatments of 1,500 to 1,800 r, 60 to 100 kv, are given on alternate days. The eye is protected by a silvered lead shield inserted under the eyelids. The lesion, with a reasonable margin, is limited by a superficial shield of barium plasticine, accurately molded to the skin surface. In fourteen days a moist exfoliation appears, which heals in another three weeks. Epilation of the eyelashes in the treated segment of the lid is permanent. In the more deeply seated growths the preservation of the eye becomes of secondary importance and the integrity of the lens must be risked. In a high proportion of cases the eye may already have been removed. High-voltage radiation 200 to 300 r daily is administered in these cases until a total of 5,000 or 6,000 r has been reached.

Only two cases of intraocular tumor have been treated both following enucleation. One patient with retinoblastoma is alive after fifteen years and the other with sarcoma of the choroid is alive after five and a half years.

Mackenzie considers radiotherapy the treatment of choice for rodent ulcers and epitheliomata of the eyelids. He believes that in certain ocular conditions resistant to ordinary forms of treatment, x-ray therapy will bring about subjective and objective improvement in about 60 per cent of the cases. Except for neoplasms x-rays should not be used as a primary therapy weapon.

Radiation Treatment of Carcinoma of the Breast Hugh F Hare. S Clin North America 26 730-732, June 1946.

Radiation treatment of carcinoma of the breast is used at the Lahey Clinic either prophylactically following surgical removal of the breast or as a palliative measure in inoperable or recurrent cases. It has not been used as a method of cure without previous operation nor has it been used as a preoperative measure in an attempt to sterilize a malignant tumor.

In the postoperative course of therapy, the breast, axilla, and supraclavicular space on the side involved are all treated, through three separate portals. The total dose usually attained is 2,400 r, measured in air, using x-rays generated at 200 kv, filtered with 1 mm of copper and 1 mm of aluminum at a distance of 50 cm. Usually, each anterior portal is treated with 100 r a day and the lateral portal receives 150 r.

Local recurrences limited to the scar or skin are given 3,000 r, measured in air, in two divided doses of 1,500 r each, or by 2,400 r administered at one exposure. If the lesions are larger than 2 × 2 cm, the divided dose method is most efficacious, as the degree of skin reaction is less, while the end result is approximately the same.

Bone metastases from carcinoma of the breast are usually treated with 1,500 r delivered in divided doses. This is usually successful in relieving pain. In menstruating women, most of the lesions are osteolytic, after the menopause, they may be osteolytic or osteoblastic. Following treatment the osteolytic lesions may become osteoblastic and may remain asymptomatic for months or even years.

Radiation castration is felt to be eminently useful in a small well defined group of patients who experience greater pain in their metastatic bone lesions during menstruation than at any other time. It should be explained to such patients that relief if it is to be obtained, will not take place for at least sixty days because the menstrual periods are not controlled immediately by irradiation treatment.

SYDNEY F THOMAS M D

Untreated Carcinoma of the Breast A Companion of Results of Treatment of Advanced Breast Carcinoma. Phyllis Wade. Brit J Radiol 19 272-280, July 1946.

For the purpose of determining the value of treatment of carcinoma of the breast as indicated by balancing the survival rate against the normal life expectancy, a series of 27 untreated cases of mammary carcinoma and 177 treated cases are statistically analyzed. It is pointed out, however, that survival rates are not the sole criterion on which to assess the effect of therapy, as the conditions of life, as well as the prognosis, may be affected. The severity of symptoms during the survival period is significant, though not susceptible to statistical analysis. It must also be taken into consideration that some patients with carcinoma die of intercurrent disease. Deaths from cancer of the breast and also deaths due to respiratory infections show an increase in the winter months. This may be interpreted as meaning either that death was expedited by intercurrent disease or that the cancer advanced more rapidly as a result of the infection.

The average age at onset in the author's untreated series was 56.7 years and the mean duration of life for 26 cases in which the time of onset was known was 32.6 months. One patient lived twenty-two years and one

thirteen years, while one died in a month. The largest number of deaths in any one three month period was 8, occurring between the twelfth and fifteenth months. While the series is too small to correlate the age of onset with duration of life, a trend is indicated, namely, that there is a longer life expectancy with a more advanced age of onset.

The duration of life following the first examination is believed to furnish a better basis of comparison with treated series in which the survival period is usually reckoned from the beginning of therapy. In the author's untreated series 11 patients died within three months of examination and 17, or more than half, within six months. All were dead within two years. A study of the treated series of 177 cases showed that treatment (radiotherapy alone or in combination with surgery) increased the survival rates by 21.5 per cent at one year, 22.5 per cent at two years, 10 per cent at three years, 10.5 per cent at four years, and 9.5 per cent at five years. Of the 177 patients treated, 39 were free of symptoms at the end of a year, 21 at two years, 15 at three years, 12 at four years, and 10 at the end of five years, so that treatment must be credited with conferring not only a rise in survival rates but also a period of healed disease for a certain proportion of the surviving patients.

The author supplements her own study of treated and untreated cases by an analysis of several series without treatment recorded in the literature totaling 777. In this group the mean duration of the disease was 38.55 months. On this basis treatment was shown to give an average gain of approximately 21.5 months of life. This figure is less significant, however, than the number of years lost as compared with the normal life expectancy for the various age groups, a matter which the author discusses at some length. She concludes with the following statement: "Thus the after-history of a group of patients treated or untreated should relate to the state of the disease at any given period and to the duration of life compared with that of an individual of the same age but not known to be suffering from the disease."

SYDNEY J. HAWLEY, M.D.

Tumor Dosage and Results in Roentgen Therapy of Cancer of the Breast. Maurice Lenz. *Am J Roentgenol* 56: 67-74, July 1946.

The results of roentgen therapy of cancer of the breast vary with the dosage which reaches the tumor. Eighty-two patients with cancer of the breast were treated between 1933 and 1937. Thirty-eight of these were irradiated preoperatively and 44 non-operated patients were treated by roentgen irradiation alone. In most an average tumor dose of less than 4,500 r was obtained. Invasion of the axillary nodes was diagnosed clinically in all 82 patients. In 18 of the 44 non-operated patients, skeletal or lung metastases were present on admission, 5 others had deep ulceration of the breast, 5 had satellite breast tumors and 17 had marked edema or fixation of the breast. Only one of these patients survived five years. Disappearance of the local tumor was observed more often in the more cohesively and slower growing well differentiated neoplasms. In spite of the large roentgen ray doses administered to these tumors, recognizable tumor cells were found in all mastectomy specimens.

Because of the experience with this group of cases it seemed desirable to administer larger tumor doses than 4,500 r. During 1938, 1939, and 1940, 46 patients with

non-operated cancer of the breast were treated solely by roentgen therapy in an attempt to arrest the growth. 2,000 r were given to each of the four quadrants of the affected breast and 1,000 to 2,500 r were added directly over the tumor in order to raise the tumor dose to 6,000 r or more. Each axilla was cross fired with 2,500 r through an anterior and posterior axillary field and with 2,500-3,000 r through a direct axillary field. The daily dose usually was 150-200 r to two opposing breast or axillary fields. Filtration varied from 0.5 to 2 mm Cu, or a Thoraeus filter was used. Exposure of the lungs was avoided as much as possible. Telangiectasia occurred in some instances and in a few irradiation sclerosis. In most, however, only slight sequelae were seen. Thirty-two cases received tumor doses of 5,000 to 6,000 r, or over. In only 8 of these did cancer persist locally. Of the other 23 patients, 14 are dead and 9 are free from clinical evidence of cancer over five years after roentgen therapy. Of the 14 dead, 4 died of cardiovascular disease without clinical evidence of cancer, one of these after five years.

It is possible that in spite of this clinical result, viable cancer cells may be locked up in the sclerotic depths of these heavily irradiated breasts and that at some time they may again start to grow actively. It is not suggested, therefore, that roentgen therapy be substituted for radical mastectomy in strictly operable cases. The important fact remains, however, that with a tumor dose of about 6,000 r or over, 23 of 31 cancers of the breast, most with axillary nodes, disappeared clinically, and in 10 of these cancer could not be demonstrated clinically five years later.

CLARENCE E. WEAVER, M.D.

Artificial Menopause and Cancer of the Breast. L. Halberstaedter and A. Hochman. *J. A. M. A.* 131: 810-816, July 6, 1946.

A review of the literature pointing up the estrogenic factor in the production of carcinoma of the breast is presented and it is noted that it is difficult to draw many firm conclusions on the benefits of castration. There appears to be, however, general agreement that its effects are definitely beneficial.

The authors add 60 cases of carcinoma of the breast in which an artificial menopause was induced by x rays. Sterilization was done chiefly for metastases. Improvement following this procedure was obtained in 56 per cent of the cases. In defining "improvement," it is emphasized that roentgenographic and objective clinical signs of regression were not considered the only valid criteria. Restriction of growth, appreciable diminution of pain, dyspnea, and other subjective symptoms when deemed significant were also considered as improvement. The response of metastases by location was as follows: metastases in bone most favorably improved (69 per cent), lungs and pleura 50 per cent improved, cutaneous metastases and local recurrences less favorably, lymph nodes showed little improvement, and brain and liver metastases none.

There was no significant difference in the relative proportion of improvement between cases classified as Stage II and III (Steinthal). Typical adenocarcinomas were more susceptible by far than anaplastic cancer to the estrogen inhibiting influence of artificial menopause.

The improvement obtained was of short duration (from one half to two years) probably because the estrogen deficit of the ovaries is compensated for by the

secretion of the hormone by other glands, presumably the adrenal, pituitary, thymus, and possibly others

L A POZNAK, M D
(University of Michigan)

Roentgen Irradiation of Lung Tumors Emilio Bianchi Schweiz med Wchnschr 76 652-653, July 20, 1946

The author reports one case of pulmonary tumor with supraclavicular metastases (biopsy of these showed squamous epithelioma). Initially a collapse of the right upper lobe was present. All findings regressed following administration of 6,000 r in 30 treatments. The patient had continued well over nine months' observation.

LEWIS G JACOBS, M D

Carcinoma of the Fundus Uteri Robert J Crossen South M J 39 445-451, June 1946

The author attempts to cover the etiology, diagnosis, classification, treatment, and prevention of carcinoma of the endometrium. He points out that child-bearing is not a significant factor in the production of fundal carcinoma as compared to its significance in carcinoma of the cervix. Because of the use and abuse of ovarian hormones without sufficient knowledge of their action on the endometrium, a group of cases has been analyzed from the point of view of age at the menopause. It was found that 60 per cent of the patients with carcinoma had continued to menstruate after the age of fifty, as compared with only 15 per cent of normal subjects. These observations and results of experimental studies suggest that the prolonged action of endogenous estrogens may play an important role in the causation of endometrial cancer.

The indiscriminate use of estrogenic substances may also confuse the diagnosis of fundal carcinoma, since one cannot be certain whether bleeding in any given case is "withdrawal bleeding" or an early symptom of malignant growth. Careful curettage is emphasized as a diagnostic measure, and its repetition is advisable if bleeding persists in spite of negative findings.

Six stages of the disease are recognized: (1) endometrium only involved, (2) myometrium involved but not beyond the middle, (3) myometrium extensively involved, (4) removable adjacent structures involved, (5) irremovable structures involved while the primary mass can still be removed, (6) surrounding structures involved to such an extent as to preclude even palliative removal of the primary tumor.

Treatment formerly by operation alone, now includes a combination of irradiation and surgery. The author favors preoperative intrauterine radium therapy and describes the method of application. The dose varies from 3,000 to 4,000 mg hours. In cases where there is no contraindication, hysterectomy is done three or four weeks later. Where there does exist a definite contraindication to the major operative procedure, the radium dose is pushed to the limit and is followed by deep x-ray therapy (dosage not given). These patients are checked in two months and again in five months to see if additional radiation is required.

SYDNEY F THOMAS, M D

The Results of Treatment in Carcinoma Colli Uteri J H Müller Schweiz med Wchnschr 76 647-651, July 20, 1946

This report deals with 133 patients treated for cervical carcinoma before 1939, allowing for from five to

seven years follow-up. In addition to the usual four stages, a fifth group was distinguished, Stage 0, consisting of the very earliest cases discovered by colposcopy and the iodine test. Stage 0 and some of the earlier Stage I cases were treated by operation (total extirpation) with postoperative x-ray therapy. The others were treated with x-ray and radium. The distribution of cases was: Stage 0, 9 per cent, Stage I, 26 per cent, Stage II, 40 per cent, Stage III, 21 per cent, Stage IV, 4 per cent. At five years the survival rates for these stages were 100 per cent, 65 per cent, 49 per cent, 29 per cent, and 0, respectively. At seven years they were 100 per cent, 58 per cent, 37 per cent, 14 per cent, and 0. The overall absolute five-year survival rate was 51 per cent. The mortality due to treatment was 4 per cent. The author emphasizes the value of early diagnosis and prefers to use the surgical approach for most early cases.

LEWIS G JACOBS, M D

Primary Malignant Bone Tumors. A Review of Cases Seen in the Radiation Therapy Department of Bellevue Hospital. Rieva Rosh and Louis Raider Am J Roentgenol 56 75-83, July 1946

This paper reviews experiences with 121 treated cases of primary malignant bone tumors. In order of radiosensitivity they are: endothelioma, multiple myeloma, giant cell sarcoma, osteogenic sarcoma, and chondrosarcoma. The best hope of cure lies in the combination of intensive radiation therapy and surgery. When there is doubt about the diagnosis, it is believed a biopsy should be done. In tumors of bone where surgery cannot be employed, the parts are treated by fractional high-voltage roentgen irradiation to skin tolerance. The dose varies from 2,100 to 3,000 r per field, depending on the size of the field and individual reaction. Where amputation is to be done, dosage as high as 4,000 r per field is used.

Forty-eight cases of *osteogenic sarcoma* were treated. Twenty-two patients were below twenty years of age and 18 were over forty years of age. With amputation and irradiation there was one five-year survival among 3 cases. With excision and irradiation there were 4 five-year survivals and 4 three-year survivals among 14 cases. With irradiation alone there was a single five-year survival out of 31 cases. This patient died after eleven years with metastases in the lungs.

There were 8 cases of *secondary osteochondrosarcoma*. Three of the patients survived more than five years. One of these 3 and the other 5 died of lung metastases. One patient survived seven years under treatment consisting of a combination of excision and irradiation.

Ewing's tumor comprises a group of highly malignant endothelial sarcomas which arise in the shafts of long bones in patients during the first two decades of life. The tumor is thought to have its origin in the lymphatic channels of the bone. It metastasizes early. It is the most radiosensitive of bone tumors, and its rapid response to radiation therapy is helpful in the diagnosis of doubtful cases. The prognosis with any form of treatment is poor. Only one of the authors' 32 patients with Ewing's tumor has survived and been observed for five years. Several have been under observation for three years.

There were 18 cases of *multiple myeloma*. Eight patients died in one year and 3 during the second year, 7 lived three or more years. Radiation therapy often gives remarkable palliative results, but the disease is invariably fatal.

Giant cell sarcoma, which in the early stage is indistinguishable roentgenographically from benign giant-cell tumor is less radiosensitive than Ewing's tumor or multiple myeloma. It was the tumor, however in which radiation therapy gave the greatest percentage of cures. It is believed that excision and irradiation is the best method of treatment. Of 6 patients, thus treated 4 were alive and well three years later. Three out of 4 who had radiation therapy alone were alive and well after three years and the fourth had died of metastases.

CLARENCE E. WEAVER, M.D.

Roentgen Therapy for Leukemia. Walter C. Popp and Charles H. Watkins. *M. Clin. North America* 30: 799-810, July 1946.

The classification of the leukemias used at the Mayo Clinic, the hematologic picture in the different types of leukemia, and the plan of roentgen treatment followed are presented.

Irradiation of the spleen through multiple small fields is preferred to other types of radiation therapy, such as irradiation of the long bones, flat bones, mediastinum or of the entire body. A moderate roentgen voltage 130 to 140 kv, has been found the most effective. The area corresponding to the spleen is divided into nine fields of approximately equal size (usually four anterior, four posterior, and one lateral). This permits nine sessions of treatments without repeated exposure of any one field. Before irradiation is started, the patient's white cell count, hemoglobin, and platelet count are investigated carefully. Beginning with one of the lower splenic fields treatments are continued daily, each preceded by a leukocyte count, until this reaches a satisfactory level. This figure varies considerably according to the type and form of leukemia. If the count seems to decrease too rapidly, treatment is discontinued for twenty-four or forty-eight hours, in order to evaluate the significance of this decrease. Treatment carried out over a relatively short period has been found to be more palatable than haphazard treatments at irregular intervals. Irradiation is resumed when the total leukocyte count begins to show a definite and persistent increase and immature forms reappear.

Patients having relatively low counts—75,000 to 100,000 cells per cubic millimeter—usually need more irradiation for the desired effect than patients with counts of 200,000 to 300,000. The count should not be allowed to fall below certain flexible limits, depending upon the original count. The leukocytes may continue to decrease for a month or more after cessation of treatment. When patients have mild leukocytosis their general condition seems better than when they have a so-called normal leukocyte count or leukopenia.

Myelogenous Leukemia. Roentgen rays are useless in the treatment of acute myelogenous leukemia, blood transfusion and other supportive measures may be of limited but doubtful value.

In spite of the rapid onset of subacute myelogenous leukemia, an isolated case may respond temporarily to small doses of roentgen rays. Using the nine fields as suggested, daily treatments not exceeding 75 to 80 r measured in air are usually given until the number of leukocytes reaches approximately one-third of the original count. Because of the radiosensitivity of the cells in subacute myelogenous leukemia there is considerable risk of excessive irradiation.

Chronic myelogenous leukemia is the least difficult form of the disease to treat and the results obtained are much

more satisfactory than in other forms. The dose administered to each of the nine fields is approximately 225 r (measured in air) and the treatments are continued daily as long as the leukocyte count does not diminish too rapidly.

Roentgen therapy in the leukopenic type of myelogenous leukemia should be administered with caution, owing to the low total leukocyte count. The daily dose should not exceed 75 r. Often a course of treatment will produce little change in the leukocyte count, but may induce a gradual reduction in the size of the spleen with clinical improvement. Usually not more than five sessions of treatments are necessary and irradiation is stopped when the leukocyte count shows any tendency to decrease.

Treatment of *aleukemic myelogenous leukemia* presents much the same problem as the treatment of leukopenic myelogenous leukemia. The leukocyte count may vary from 2,000 to 10,000. Fifty to 75 r are given, and the precautionary measures described for the leukopenic phase must be observed. If the decrease in leukocytes with the initial treatment is sudden, then twenty-four to forty-eight hours should elapse before further irradiation.

Lymphatic Leukemia. Treatment for acute lymphatic leukemia is the same as for acute myelogenous leukemia. Roentgen therapy is of no value.

Roentgen therapy of subacute lymphatic leukemia is likewise of doubtful value. Greater care must be employed in the treatment of this form of leukemia than of the chronic form because of the sudden changes which may occur in the leukocyte count. The areas of involvement, whether they be cervical, supraclavicular, axillary, retroperitoneal or mediastinal nodes are treated with 75 to 100 r per field. One treatment is given each day until a satisfactory level is reached or as long as the leukocyte count does not decrease too rapidly.

In chronic lymphatic leukemia treatment of the involved areas is given for a variable period, the number of treatments depending on the elevation of, and the effect of irradiation on the leukocyte count. Treatment is administered to the involved lymph nodes instead of the spleen. The dosage 225 r per field daily, is comparable to that used in chronic myelogenous leukemia.

In the chronic macrolymphocytic and mesolymphocytic forms of leukemia higher doses of roentgen rays cause extreme fluctuation in the leukocyte count. A reduction of as much as 50 per cent can take place in twenty-four hours with excessive treatment. Although this rapid change is dangerous in any leukemia the real danger in this form is not only in the rapid reduction of the white cells but in the effect on the chemical constituents of the blood—the concentration of urea may double or even triple. A daily estimation of urea concentration is as important as the daily leukocyte count, and if the concentration is increased treatment should be interrupted for several days until it returns to normal. During the past few years at the Mayo Clinic roentgen radiation has been directed to the renal areas for its effect on the leukemic infiltration in the kidney and improvement of kidney function. Not more than 100 to 125 r per field should be used with a moderate voltage technique. One treatment a day is given until the leukocyte count reaches the desired level.

Monocytic Leukemia. Two types of monocytic leukemia are recognized—the Schilling type in which the cells are derived from the reticulo-endothelial system,

and the Naegeli type, in which the monocytes are regarded as developmental products of the myeloid series. Roentgen treatment is similar to that for myelogenous leukemia.

Subleukemic Splenic Reticulo-Endotheliosis This form of leukemia is characterized by anemia, splenomegaly, fever, purpura, leukopenia, and thrombocytopenia. Treatment presents the same problem as treatment of aleukemic and leukopenic myelogenous leukemia. Daily dosage should not exceed 75 r to small fields over the spleen. The total leukocyte count usually does not exceed 10,000 and need not be reduced below a level of 4,000 to 5,000. A good clinical response and reduction in size of the spleen can be obtained.

The authors believe that roentgen irradiation is as good a therapeutic measure in leukemia as is known at the present time.

Biological and Technical Discussion of Panroentgen Therapy [Whole Body Irradiation] Arduino Ratti. *Radiol med (Milan)* 32: 206-227, June 1946.

Ratti discusses the biological principles of whole body irradiation and states that the usual criteria of dosage and penetration do not apply here. He has used the method for leukemia, lymphogranuloma, and generalized malignant tumors. The best results can be expected in cases of chronic leukemia, in lymphogranulomatous and metastatic conditions, localized roentgen therapy will give better results.

CESARE GIANTURCO, M D

Selective Radiation Obtained by the Intravenous Administration of Colloidal Radioactive Isotopes in Diseases of the Lymphoid System P F Hahn and C W Sheppard. *South M J* 39: 558-562, July 1946.

Retention and Excretion of Manganese Dioxide Administered Intravenously to Humans C W Sheppard and P F Hahn. *Ibid* pp 562-565.

In these two articles, the authors appraise the results of the use of the artificial radioactive isotopes in therapy and discuss the use and excretion of colloidal manganese dioxide. The radioactive isotopes of iodine and strontium are briefly mentioned for use in Graves' disease and

bone sarcomata respectively. The authors believe that, because of its biological behavior, the use of radioactive phosphorus is favorable in polycythemia and myelogenous leukemia but is not so reasonable in the treatment of chronic lymphogenous leukemia, lymphoma, and Hodgkin's disease.

Evidence suggests that the distribution of highly dispersed sols, after injection into a vein, is in rough proportion to the amount of lymphoid tissue; one might expect to obtain a desired selective radiation effect on those tissues affected in lymphatic leukemia, reticulo-endotheliosis, and in certain cases of lymphoma. With particles approaching colloidal size, as much as 90 per cent are taken up by phagocytic cells of the liver. Other participating tissues are the spleen, kidney, and lungs.

Criteria to be applied in the selection of isotopes are particle size, chemical and biological behavior of the element, its "half-life," length of ionization path, and cost of production.

Radioactive manganese, prepared in the cyclotron by bombarding chromium with deuterons, meets most of the requirements. Intravenous use of this element in a gelatin colloidal sol has not produced any clinical reaction such as nausea or fever. The early results in a comparatively few patients treated by this method of selective irradiation of the lymphoid macrophage system are reported as promising.

It is pointed out that in evaluating the therapeutic effect, retention and excretion are highly important considerations. The principal fraction of manganese released is excreted by way of the bile, appearing in the stools; in the first stool it is estimated to be of the order of 5 per cent of the initial dose. Subsequent to this the rate of excretion drops sharply and remains at a relatively low rate. Gamma ray measurements also indicate that the mean bodily activity falls only slightly below the typical decay curve of 6.5-day manganese.

At present conservative practice is recommended concerning the amount of 310-day manganese (the much smaller quantity of the two radioactive isotopes produced by chromium bombardment) which may be allowed to accumulate in a patient.

RUSSELL WIGH, M D

EFFECTS OF RADIATION

Health Protection in the Production and Use of Atomic Energy William F Bale. *Occup Med* 2: 1-7, July 1948.

The author points out the magnitude of the increase in radioactivity incident to the use of nuclear energy on a world wide scale and emphasizes the importance of a peacetime program of fundamental research pains takingly and unhurriedly carried out in which the whole question of radioactive tolerance can be investigated in a systematic fashion. He warns of the dangers in the use of radioactive tracers. Part of the freedom from trouble in this respect in the past may have been due to the difficulty of producing dangerous amounts of most radioactive isotopes with the cyclotrons available. This safeguard probably will not exist much longer.

Postirradiation Pulmonary Fibrosis. Irving Innerfield. *New York State J Med* 46: 1572, July 15, 1946.
A case of pulmonary fibrosis which developed following six preoperative and thirty two postoperative deep

x ray treatments and two preoperative radium treatments for cancer of the breast, is reported. The treatment was administered by a surgeon, not a radiologist, and the dosage factors are not given.

Histopathological Study of Radionecrosis Mauro Piemonte. *Radiol med (Milan)* 32: 192-202, 1946.

The author has studied microscopically 24 cases of radionecrosis. He holds that the condition is primarily due to progressive traumatic changes in the small vessels of the irradiated area. Thrombotic vessels mean ischemia. The vessels already injured by radiation are in poor condition to withstand an advanced degree of ischemia and die.

CESARE GIANTURCO, M D

Quantitative Histologic Analysis of the Effect of X-Radiation on the Interstitial Tissue of the Testes of LAF₁ Mice Allen B Eschenbrenner and Eliza Miller. *J Nat. Cancer Inst.* 6: 343-348, June 1946.

The authors attempt to demonstrate that the inter-

stitial tissue actually is increased only relatively in the testes of mice following irradiation. They do this by a very ingenious method whereby the sections of the testes are examined, and two thousand random observations are made on each testis, and the amount of interstitial tissue is thereby estimated. The irradiation was carried out in two orders of magnitude, 300 and 600 r total body irradiation in divided doses of 10 and 8 r, five and six times per week, respectively.

There is apparently considerable controversy as to the relative and real amounts of interstitial tissue remaining in the testes. By careful checking, it is clearly demonstrated that, although there is shrinkage of the tubules, the actual amount of interstitial tissue increases only relatively and not absolutely.

SYDNEY F. THOMAS, M.D.

Increase in Incidence of Lung Tumors in Strain "A" Mice Following Long-Continued Irradiation with Gamma Rays Egon Lorenz, Walter E. Heston, Margaret K. Deringer and Allen B. Eschenbrenner. *J. Nat. Cancer Inst.* 6: 349-353, June 1946.

Strain "A" mice of both sexes were exposed daily for

eight hours to total body irradiation by radium sulfate (8.8 r) and were killed after nine and a half months, having received a total dose of $2,500 \text{ r} \pm 10$ per cent. The incidence of pulmonary tumors was approximately 30 per cent higher in these mice than in unirradiated controls. This result is statistically significant and is interpreted as showing a weak carcinogenic action of the radiation.

The application of these results to man is difficult. The authors cite the example of the miners of Schneeberg and Joachimsthal, among whom approximately 50 per cent of deaths are due to pulmonary tumors. They place the absorbed energy per gram of lung tissue in this group at 1×10^4 ergs as compared with 2×10^4 ergs for their experimental animals. The inference is that the inhalation of radon is not the sole factor in the production of tumors in the miners.

Another point made by the authors is that their studies were made on a strain of animals with a high spontaneous incidence of pulmonary tumors, while in the general population the incidence of such tumors is low, only 0.1 per cent. The results obtained in this study it is believed might not be detectable in a low tumor strain of mice. SYDNEY F. THOMAS, M.D.

EXPERIMENTAL STUDIES

Studies on Wounds of the Abdomen and Thorax Produced by High Velocity Missiles William O. Puckett, William D. McElroy, and E. Newton Harvey. *Mil. Surgeon* 98: 427-439, May 1946.

Damage to Peripheral Nerves by High Velocity Missiles Without a Direct Hit William O. Puckett, Harry Grundfest, William D. McElroy, and J. H. McMillen. *J. Neurosurg.* 3: 294-305, July 1946.

The first of these studies concerns wounds produced in the abdomen and thorax of living anesthetized cats by high velocity missiles. High speed motion pictures showed an initial swelling (1-2 milliseconds) followed by a period of collapse (4-5 milliseconds) with subsequent external bulging of the abdominal walls of greater duration but less intensity. Microsecond roentgenograms showed the formation of a large temporary cavity coincident with the initial abdominal expansion. High-speed motion pictures revealed no such volume changes in the thorax as were observed in the abdomen and microsecond roentgenograms failed to demonstrate well-defined temporary cavities.

Autopsy studies on the abdomen showed internal damage far out of proportion to the small wounds of entrance and exit. The general effect is that of an explosion within the abdomen. Structures directly in the path of the missile are badly damaged. Structures well away from the missile track also show extensive damage probably due to the effect on gas pockets of rapid pres-

sure changes associated with the formation of the temporary cavity.

The object of the investigation of damage to peripheral nerves by high velocity missiles was (1) to demonstrate visually that a nerve can be subjected to rapid displacement and deformation by a missile which does not strike the nerve directly and which produces no interruption in its gross anatomical continuity and (2) to show that such displacement of the nerve can result in its functional and anatomical damage. The sciatic nerves of anesthetized cats were visualized by radiopaque media. Microsecond roentgenograms showed that the nerve is rapidly blown aside during the expansion of the large temporary cavity which is formed by a high velocity missile which passes near but does not strike the nerve directly. Conduction studies showed that functional damage can be produced in nerves that have been subjected to such displacement, even though no break in the continuity was produced.

Histologically the loss of function was found to be due to a series of minor breaks within the nerve sheath. This type of damage can be explained by the compression and stretching which the nerve undergoes as it is rapidly blown aside during the expansion of the temporary cavity which forms in the tissues immediately after the passage of the missile. The importance of recognizing this type of nerve injury before attempting drastic operative measures is emphasized.

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Carcinoma of the Skin Influence of Dosage on the Success of Treatment¹

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THIS STUDY was undertaken in an attempt to evaluate the effect that a given number of roentgens, delivered to a carcinoma of the skin, had upon the success or failure of treatment. By comparing the results in large groups of lesions each given a different dosage, it was hoped that an optimum dose might become apparent. With the establishment of such an optimum dose, the existing confusion as to the proper roentgen dosage for skin cancer should be considerably lessened, and a standard of treatment more uniform throughout the country might be accepted.

It is a well recognized fact that few patients die of carcinoma of the skin, and also that recurrence, even after months and sometimes years of apparent cure, is not uncommon. A study based on three- and five-year cures following treatment of these lesions is never entirely satisfactory, largely because approximately 25 per cent of the patients affected by skin

cancer, due to their age, die of intercurrent disease within five years from the time of treatment. Also, many of these patients are too feeble for the enforcement of routine follow-up, and on this account many real five-year cures may be listed as lost.⁴

In the present discussion, the word "failure" will be used arbitrarily to indicate both those cases in which the lesions were not immediately destroyed by a given treatment and those in which there was later (months or years after treatment) recurrence. (Actually, most of the lesions referred to as failures were subsequently destroyed or controlled by irradiation or surgery.) In only 3 of the entire group studied could the carcinoma of the skin be considered as a contributing cause of death. Undoubtedly, a certain number of lesions classified as successfully treated recurred without our knowledge, or may still recur. Any such inaccuracies, however, should not influence the

¹ From the Department of Radiology, Massachusetts General Hospital, Boston 14, Mass. Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-6, 1946.

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* Board of Consultation, Massachusetts General Hospital.

⁴ An analysis by the methods of Warren *et al.* (2, 3) and Magnusson (1), of the known three-year and five-year cures in this series will be discussed in a later paper.

stitial tissue actually is increased only relatively in the testes of mice following irradiation. They do this by a very ingenious method whereby the sections of the testes are examined, and two thousand random observations are made on each testis, and the amount of interstitial tissue is thereby estimated. The irradiation was carried out in two orders of magnitude, 300 and 600 r total body irradiation in divided doses of 10 and 88 r, five and six times per week, respectively.

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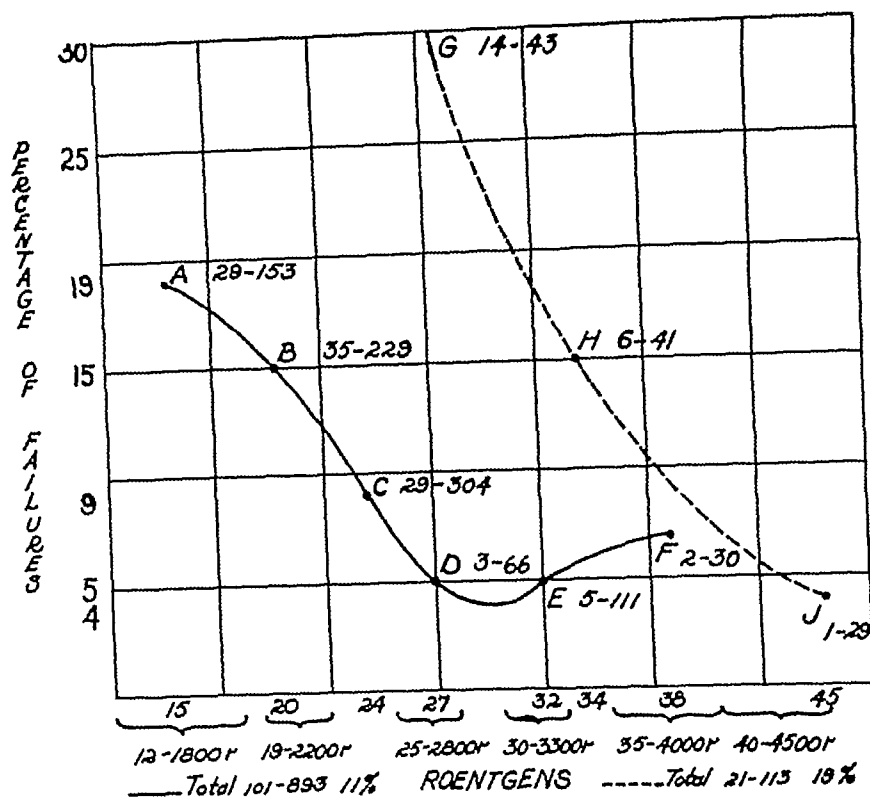


Fig 1 Comparative results of treatment of cutaneous cancer. Solid line represents group treated with massive single-dose irradiation (893 lesions). Broken line represents those treated with multiple doses, fractionated within one week (113 lesions).

- A 29 failures (19%) in 153 lesions given 1,200-1,800 r
- B 35 failures (15%) in 229 lesions given 1,900-2,200 r
- C 29 failures (9%) in 304 lesions given 2,400 r
- D 3 failures (5%) in 66 lesions given 2,500-2,800 r
- E 5 failures (5%) in 111 lesions given 3,000-3,300 r
- F 2 failures (7%) in 30 lesions given 3,500-4,000 r
- G (fractionated) 14 failures (32%) in 43 lesions
- H (fractionated) 6 failures (15%) in 41 lesions
- J (fractionated) 1 failure (4%) in 29 lesions, dosage \approx 4,500 r

Among the total 1,035 lesions treated with radiation, there were 26 in which radiation ulceration developed several months to several years after complete healing. All 26 ulcerations occurred in lesions that had received a single treatment or a single course of treatments. In 12, the dose had been 3,000 r or less, in 11, between 3,000 r and 4,000 r, and only 3 lesions had received over 4,000 r. Although the size of a given cancer of the skin must always be considered in estimating the probability of the development of a late radiation ulcer, it must be borne in mind that this complication may also follow the treatment of a relatively small lesion. Of the 26 radiation

ulcers, 10 occurred after treatment of lesions 1 cm or less in diameter, 12 in lesions between 1 and 2 cm, and only 4 in lesions larger than 2 cm. It is well known that treatments repeated over a period of months or years greatly increase the likelihood of the development of radiation ulceration, but it would seem that, in the past, proper emphasis has not been given to the danger of radiation ulcer resulting from the irradiation of a small lesion to which but a single treatment (or a single course of treatment) has been administered. During the past fifteen years, approximately one-third of the total number of radiation ulcers associated with the treatment of skin carcinoma at this

comparative results, since they should apply more or less equally to all groups regardless of the roentgen dosage used.

Approximately 1,500 carcinomas of the skin were reviewed for the purposes of this study (Lesions of the mucocutaneous junctions are not included.) They were found on 1,300 patients. The lesions were taken in the order in which they appeared on the hospital files between the years 1930 and 1944 inclusive. The group is a selected one only to the extent that lesions which had received treatment elsewhere, prior to admission to the Massachusetts General Hospital, were discarded. This was done because the purpose of the study was to evaluate the various methods of treatment used at this hospital. Ten hundred and thirty-five lesions were irradiated with x-ray and 387 were treated surgically. Histologic examination in 630 of the total group showed epidermoid carcinoma in 183 and basal-cell carcinoma in 447. In the remaining cases, treatment was given without histologic confirmation because the clinical appearance was characteristic of carcinoma of the skin. A few benign lesions may have been included in the latter group, due to error in judgment, but such diagnostic errors would be fairly equally distributed throughout the different dosage groups and should not affect the proportional results. Seventy-eight of the 129 so-called failures in the irradiated group were proved by biopsy, 61 (78 per cent) were basal-cell and 17 (22 per cent) epidermoid carcinomas.

No lesion was included in the analytic study in which the follow-up had been less than one year, 63 of the initial group were discarded on this account. Sixty-eight per cent were followed two years or more, 25 per cent five years or longer.

The dose of radiation varied from 1,200 r to 6,000 r measured in air. In 89 per cent of the irradiated group, radiation was given in a single massive dose, while in the remainder it was fractionated over a period of from one to three weeks. Of the 893 lesions receiving a single massive treatment, 54 per cent were irradiated with

200 kv, 0.25 mm Cu filter, 20 cm STD, half value layer 0.6 mm Cu, while the other 46 per cent were treated with 100 kv, the half-value layer of which was 1 mm Al.

The solid line of Figure 1 is a curve plotted on the percentage of failures resulting in the various dosage groups, to each of which a different number of roentgens were administered in a single dose. On the supposition that such a graph forms a fair comparison of the success of a given treatment, the fewest number of roentgens used at the most favorable point of the curve is accepted as a so-called optimum dose. Among the 893 lesions analyzed, there were 101 failures. The contour of the curve indicates a very definite improvement in the results of treatment as the dosage was increased up to approximately 2,700 r. It does not suggest that any improvement in the results followed the increase in dosage from 2,700 r to 4,000 r. It seems reasonable therefore, to accept 2,700 r as the optimum number of roentgens to be administered in the treatment of cancer of the skin by this method. No claim is made that the universal application of this amount of treatment will produce 95 per cent cures, but it is evident that in the treatment of nearly 900 lesions, 2,700 r was as effective in destroying the carcinoma as any of the dosages used. It has the added advantage of carrying with it a lesser likelihood of leading to post-irradiation complications than larger doses.

It is appreciated that the number of roentgens to be given to an epithelioma should not be determined entirely in terms of the surface dose, but that the number delivered to the deepest portion of a lesion must be taken into consideration as well (4). In this study, the doses mentioned indicate the number of roentgens delivered to the skin and, by and large, apply to lesions of average thickness. Every radiation therapist should routinely estimate the depth dose so that the amount of radiation delivered at the deepest portion of a tumor can be kept fairly constant by increasing the surface dose in proportion to the depth of the tumor.

Table III presents a breakdown of all the irradiated lesions included in this study from the point of view of the incidence of failure associated with the size of the lesion. In lesions of 2 cm diameter or over, failures were twice as frequent as in those of 1 cm or less. This fact, however, does not prove that the incidence of failure is always twice as great when the treated lesion is a large one. Table III does not take into consideration the dosage or the method of treatment used, and errors in either of these two factors may have been just as responsible for failure as the size of the lesion.

There is a tendency among radiologists to "think twice and then reconsider a second time" (and rightly so) before giving to a large area the same dose that would readily be given to a small one. On this principle, many large lesions may fail to respond to irradiation because of underdosage. In this clinic, the trend has been to use fractionated doses in the treatment of large lesions because of the common belief that by this method a larger dose could be delivered more safely and with less discomfort to the patient. On the assumption that 4,500 r in fractionated doses delivered within one week is the optimum dose, it is apparent from Table I that all but one of the failures received less than this optimum dose. In the treatment of large skin carcinomas, the point to be stressed is that the therapist should decide before treating whether or not it is reasonably safe to attempt to destroy the lesion with the dose that has a fair chance of doing so. If it is decided that destruction of the cancer by irradiation should not be attempted, surgical removal should be seriously considered.

If an optimum radiation dosage, which would give a 90 or 95 per cent cure prognosis, could be established, the therapist might well be content. It seems inevitable that 100 per cent cures can seldom be attained, error in judgment in estimating the size of the field to be irradiated, as well as technical errors, will probably always cause a few failures per hundred

TABLE III INCIDENCE OF FAILURES IN SKIN CANCER ACCORDING TO SIZE OF LESION

	Total	Diameter (centimeters) of Lesion—		
		1 or less	1 to 2	2 or more
Number irradiated	1,035	644	305	86
Number failures	129	68	42	19
Per cent failures	12	11	14	22

Increase in the number of roentgens up to tremendous doses, such as 6,000 to 10,000 r, will not eliminate this small percentage of failures. The use of such doses would be justified only if it resulted in a significant decrease in the number of failures. If this is not accomplished, the obvious optimum dose is the lower of two doses giving essentially the same chance of cure, since the lower dose leaves the irradiated area much less liable to post-irradiation complications.

Presentation of the results of treatment based on so-called failures rather than on the curability of the lesion is misleading to a certain extent. For a fair evaluation of the various methods of treatment used, however, it has seemed more reliable, since one is dealing with patients whose ages alone predispose them to death from intercurrent disease within a relatively short time after treatment. A review of the 129 failures in the group treated by x-ray is of interest when the cases are divided according to the time after treatment that failure was noted. Within six months after treatment, 64 per cent of the failures were evident, 15 per cent were recognized during the second six months, 12 per cent between twelve and twenty-four months after treatment, and only 9 per cent occurred in lesions that had been cured for two years or more.

SUMMARY

Tabulation of the results of the single massive dose method of irradiation in carcinoma of the skin, over the range of the various doses used, showed that 1,200 r to 1,800 r gave only an 81 per cent chance of destroying the lesion. The administration of 1,900 r to 2,200 r did not offer bet-

hospital have developed following a single treatment (or course of treatments) An interesting observation made during the study of the 26 radiation ulcers was that all but 2 developed in the scar of a lesion that had been treated with the shorter wave length, half value layer 0.6 mm Cu⁵

TABLE I COMPARATIVE FAILURES WITH FRACTIONATED TREATMENT OF SKIN CANCER (Total delivered within one week)

Dosage Roentgens	Number Cases	Failures
2400-3000	43	14(33%)
3200-3600	41	6(15%)
3700-4500	29	1(4%)

Table I compares the results of different dosages in 113 lesions irradiated by the fractionated method, the treatments being delivered during the period of one week. In the group given 3,700 r to 4,500 r, the majority of lesions received 4,500 r.

The data shown in Table I appear also on Figure 1, being represented by the dotted line. Comparison of the two curves on Figure 1 makes it evident that between 3,200 r and 3,600 r, fractionated within one week's time, must be delivered in order to obtain results as good as those obtained with 1,900 r to 2,200 r given in a single treatment. Approximately 4,500 r in multiple doses within one week must be given to secure results equivalent to those resulting from a single dose of 2,700 r. In other words, the optimum dosage for fractionated treatment (within one week) is about 4,500 r and corresponds to 2,700 r as the optimum for the single-dose method. On the other hand, the number of lesions treated by the former method is too small (113) to warrant as unqualified acceptance of this standard as in the case of the single dose method. The suggested optimum dosage of 4,500 r, however, corresponds fairly closely with the dosage recommended by other large clinics with considerable experience in the fractionated form of irradiation.

From a practical point of view, treat-

TABLE II COMPARISON OF FAILURES IN SKIN CANCER WITH DIFFERENT METHODS OF TREATMENT

Type of Treatment	Number Cases	Failures
Single 200 kv *	504	63(13%)
Single 100 kv †	389	38(10%)
Multiple 200 kv *	125	27(22%)
Multiple 100 kv †	17	1(6%)
Total Irradiated	1,035	129(12%)
Treated Surgically	387	47(12%)
ALL METHODS	1,422	176(12%)

* H v l 0.6 Cu

† H v l 1.0 Al

ment of a skin cancer with fractionated doses has one distinct advantage, in that it minimizes the seriousness of a technical error if one should occur. It is debatable, however, whether this advantage outweighs the economic saving which the single dose method offers both to the patient and the busy clinic. The validity of the frequent statement that treatment of a cutaneous carcinoma should be fractionated so that the skin reaction may be lessened is questionable if the radiation is delivered within one week and the doses are comparable, that is, 4,500 r given by the former method and 2,700 r in a single treatment.

Table II shows the over-all results in the entire group studied, analyzed according to the type of treatment, without regard to the dosage used. It will be noted that the incidence of failures is the same in the group treated surgically and the group given roentgen radiation. In the latter group, dosage is obviously not the sole factor determining the result of a given treatment. An error in judgment in the estimation of the size of the subcutaneous portion of a lesion will result in failure in spite of adequate dosage to the irradiated portion of the tumor. An occasional failure may be due to the inability of a patient to remain precisely positioned throughout the entire period of treatment. In a few instances, the lesion may fail to respond even to tremendous amounts of radiation because of the actual radio-resistance of the tumor itself. Furthermore, as has been mentioned, the size of the lesion may influence the result of treatment.

⁵ A more complete discussion of radiation ulcers will be presented in a subsequent paper.

doses were in all instances divided. All my doses are given in one of two ways, depending upon the distance at which the patient lives—two one week apart or three separated by intervals of a day, that is, the entire treatment is given within one week, whether it is divided into three doses or two.

Some of these breakdowns occur without any exciting cause. To illustrate, some years ago I treated a carcinoma of the lower lip near the left angle of the mouth, and several years later an exactly similar lesion appeared on the opposite side. This second lesion was given the same dose of radiation to an area of the same size as the first. About a year and a half later there was a radiation breakdown in the second lesion, though the first had never caused any trouble. The patient was positive that he had a recurrence and wanted surgery. The surgeon did a biopsy and found chronic inflammation, which was well in the usual less than three months' time.

Sunburn may start these breakdowns. I treated a lesion on the crown of the head with radium. A couple of years later the patient, who was bald, forgot to wear his hat and acquired a good sunburn. The center of the lesion broke down and healed in the usual way in about two and a half months. An interesting thing to me is that these breakdowns usually heal leaving less scar than the original lesion, and that they all heal within three months. The treatment I have used consists in application of an ointment known as Veracal, which is 50 per cent aloes vera jelly in an oil and-water emulsion base. This is applied in the usual manner, but under wax paper, and changed as needed, and I see the patients often enough to keep them from worrying too much about a recurrence, which is what they usually think has happened.

I am interested in seeing what my future results will be, because I have just changed from a half-value layer of approximately 0.8 mm Al to a half-value of 1.8 mm Al. That is the half-value layer I get at 100 kv with the inherent filtration in the machine I am now using, which is supposed to be equivalent to 1 mm Al. I have treated a number of lesions of 5 cm or more with high voltage, copper filtered radiation, a half-value layer in copper of 1.15. I split the dose into 250 to 300 r a day, measured on the skin, as all my doses with high voltage are controlled with an integron, and I usually give a total of 4,500 to 5,000 r measured in this way. So far, the only breakdown I have had following this treatment was on a hand, following severe trauma, and several of these patients were treated a number of years ago.

Arthur W. Erskine, M.D. (Cedar Rapids, Iowa). As Dr. O'Brien has suggested, I think it would be interesting if the number of failures were plotted against the size of the lesion and the age of the patient.

I was a little surprised at what Dr. Ullmann said about these radiation ulcers healing without any trouble. We see them on the lip in elderly patients—sixty years old—and they do not heal very well, and we have them excised.

I am one of those who believe that anybody's method is good. We used to hear George Grier say that all epitheliomas should be treated with unfiltered x-rays. On the other hand, when we first started to use 200 kv copper-filtered rays somebody would tell us how much better that method was. It seems to me that quality has very little to do with our number of failures. I made a study at one time of several hundred epitheliomas and, because there were so many of them, I confined my remarks to the failures and tried to analyze the reasons for them. There were many—the stage of the disease, the age of the patient, the degree of malignancy, and a number of others, including over-treatment and under-treatment. I found that for each patient to whom I wished I had not given so much there were nine patients to whom I wished I had given more treatment.

Dr. Hale (closing). I believe I can best answer Dr. O'Brien's question by giving the comparative results obtained in the treatment of the large and small lesions. In the group of lesions which were approximately 1 cm in diameter, there were 11 per cent failures, in the group which were approximately 2 cm in diameter, there were 14 per cent failures, while in the group measuring 2.5 cm or more, there were 22 per cent failures. Sixty-two per cent of all the lesions fell into the 1 cm group, 30 per cent fell into the 2 cm group, while only 8 per cent exceeded 2.5 cm.

One's first impression of these results—22 per cent failures for the larger lesions *versus* 11 per cent for the small lesions—would be that it is considerably more difficult to destroy the larger lesions. I do not believe, however, that the difference is as great as these figures would suggest since, as you may recall, we were inclined to treat the larger lesions with a fractionated type of therapy and, if our constructive minimum-optimum dose is roughly correct, they were obviously under-treated. It is my impression that the high percentage of failures in the treatment of larger lesions can be accounted for, in part at least, by the relatively smaller effective dose which they received.

ter than an 85 per cent chance, while the delivery of 2,400 r might raise the expectancy to 91 per cent. A constructed curve showed that a lesion was as likely to be destroyed with a 2,500 r to 2,800 r range as with the delivery of 4,000 r. In the group of cases studied, therefore, approximately 2,700 r may be considered the optimum dose, since it produced as satisfactory results as higher dosages and at the same time might be expected to leave the irradiated area in better condition.

Comparison of results obtained by multiple treatments within the period of one week and by the massive single-dose method indicates that 3,200 r to 3,600 r must be delivered by the former method to produce the same results as were obtained by 1,900 r to 2,200 r by the latter. Approximately 4,500 r delivered in multiple treatments within one week produced essentially the same results as 2,700 r given at one time. This dosage, 4,500 r, is suggested, therefore, as the optimum dose to be delivered to a carcinoma of the skin when the fractionated method (within one week) is to be used.

Twenty-six late radiation ulcerations were observed following the treatment of lesions which were not extensive in size and which did not receive more than a single treatment, or a single course of treatments. Ninety-two per cent developed following the use of heavily filtered radiation (half value layer 0.6 mm Cu), while only 61 per cent of the total lesions were so treated. The roentgen dosage responsible for these ulcers would not be considered excessive by most standards. The fact that late radiation ulceration does develop following the treatment of a small lesion with a relatively small amount of radiation makes questionable the routine treatment of all skin cancers with an excessive dose of radiation in the false hope of obtaining perfect results. The chance of destroying the lesion with a much smaller amount is essentially as good as with the tremendous dosage, and the danger of subsequent complication to the patient is much less. If necessary, the few lesions that may recur

because of inadequate dosage may be successfully treated later by surgical removal.

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DISCUSSION

Frederick W O'Brien, M D (Boston, Mass.) I think Dr Hale is to be congratulated for having done a nice piece of work, and perhaps he will carry it even further. I would be particularly interested in knowing the relationship of the size of the field to his results, that is, if in all these cases ports of only 1 cm or 2 cm were used. While I believe he has shown that the radiation quality is probably not too important, I am sure the size of the field might very definitely have some significance in the types of therapy that he referred to, 100 and 200 kv.

I was also interested in the end results—about 12 per cent of failures with surgery or with irradiation. Most of us have thought for a good many years it did not make much difference whether one used surgery or x ray in these cases, the results were about the same.

Dr Hale has confirmation in recent literature for his point regarding fractionated doses. Poulson, in *Acta Radiologica*, showed very definitely that the biological effect is less with fractionated radiation in carcinoma than it is with continuous therapy.

I do not know whether the intensity rate would be important in these very small lesions, or not, I think it might well be in the larger lesions.

Henry J Ullmann, M D (Santa Barbara, Calif.) Before this Society a few years ago, in this hotel, I reported what I call late radiation breakdown in 3.6 per cent of cancers of the skin that I had treated. These lesions all exceeded 1 cm in diameter. Most of them were 2 to 2.5 cm. The breakdowns all occurred between one and a half and two years following irradiation. The

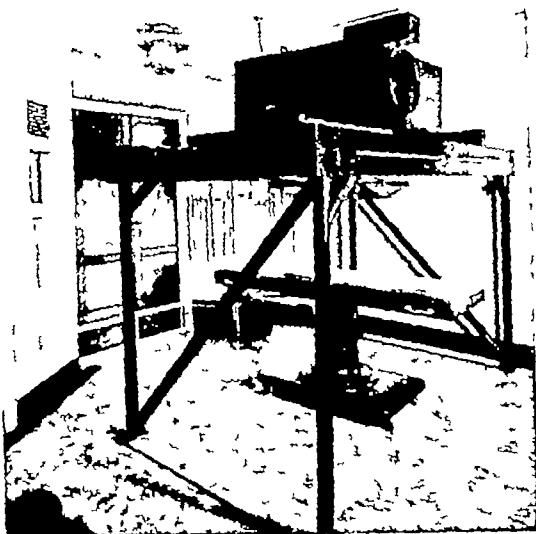


Fig 2 Multiple port apparatus in use at the Bethesda Hospital (Zanesville Ohio)

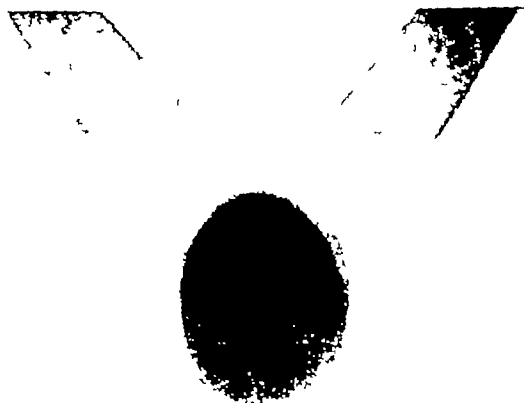


Fig 3 Film placed perpendicularly through center of opposing ports of simultaneous cross radiation apparatus. Note density of beams at the top of the phantom, gradually diminishing and again increasing at the area of cross radiation. The oval shadow is produced by beams entering at right angles. Also note the fading of x ray beams beyond area of cross-radiation

rectly to a neoplasm tend to keep the saturation point constant and the result compares favorably with that obtained in superficial therapy

A carcinocidal dose can be administered with simultaneous irradiation at any depth. This is made possible by the great number

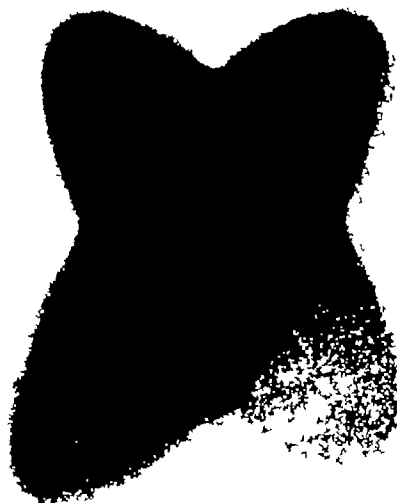


Fig 4 Film placed perpendicularly half way between the four ports. Line represents surface of phantom (or skin area)

of ports of entry (32 or more) through which x-ray beams are brought to converge on any specific area, producing a homogeneous radiation effect. Even in lesions of lesser depth, such as cancer of the breast, there is an advantage in cross-radiation, since the x-ray beams are tangential to the underlying structures and injuries to the lungs, pleura, and the like, such as often occur with perpendicular x-ray beams, are avoided.

Due to technical difficulties encountered with vacuum pumps, the original model described in the first published report was replaced by the present one, which has been in use since 1939. It consists of a shock-proof, oil-filled, lead-lined steel tank containing a 200-kv transformer surrounded by four balanced x-ray tubes. The oil is cooled by a continuous flow of tap water

Simultaneous Cross-Radiation¹

M A LOEBELL, M D

Zanesville, Ohio

IN A PAPER published in February 1938, the advantages of simultaneous cross-radiation were discussed by the writer and a description was given of an apparatus built by the Kelley-Koett Manufacturing Co for that specific purpose. Eight years of constant use have shown that this method of irradiation has decided advantages, and case reports are submitted to substantiate this claim.

Theoretically, the ideal method of irradiating a tumor would be to give a saturation dose and then repeated smaller doses at frequent intervals, keeping the saturation point constant during the entire cycle of malignant cell mitosis. Practically, this can be accomplished in superficial lesions, but in deep-seated tumors the danger to adjacent healthy tissues constitutes an obstacle. This difficulty is solved in part by changing the position of the patient, or the ports of entry, or both, in such a manner that the roentgen-ray beams cross their own path at a certain depth below the skin, producing a radiation effect of greater intensity at tumor depth and distributing the superficial dose over a larger area.

Many radiologists believe that failure to obtain uniform good results in irradiating deep-seated tumors is due to the fact that one cannot administer a carcinocidal dose quickly enough without injury to surrounding normal tissue. The time which elapses between exposures induces failure, for it is well known that the radiation effect diminishes proportionally as much as 50 per cent every twenty-four hours. Simultaneous cross-radiation is based on the principle of administering quickly large doses of radiation at depth and distributing the superficial dose over large areas through a great number of

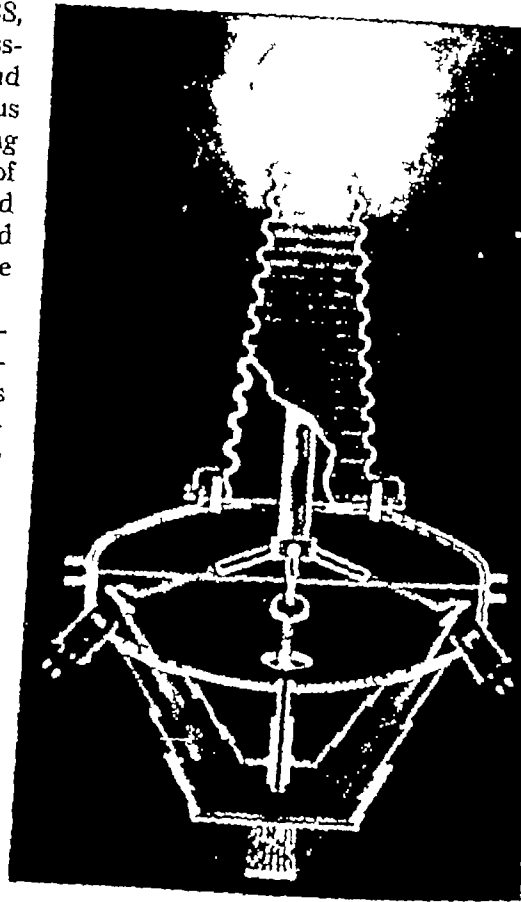


Fig 1 Section of the original Loebell simultaneous cross radiation therapy tube (fourth target out of view)

ports at the same time. The advantage lies in the fact that a carcinocidal dose can be administered to a neoplasm while the tumor bed, receiving a non-lethal dose, recovers quickly and is capable of replacing destroyed malignant structures with benign fibrous tissue, blood vessels, and the like. Lymphoid tissue and young metastatic islands outside of the tumor area, being more radiosensitive, are also gravely affected. Large daily doses applied di-

¹ Read by title at the Twenty ninth Annual Meeting of the Radiological Society of North America Chicago
Dec 1-2, 1943 Submitted for publication in October 1946

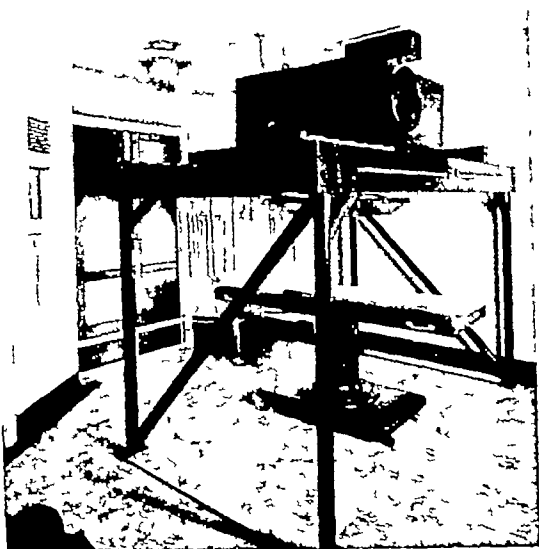


Fig 2 Multiple port apparatus in use at the Bethesda Hospital (Zanesville Ohio)

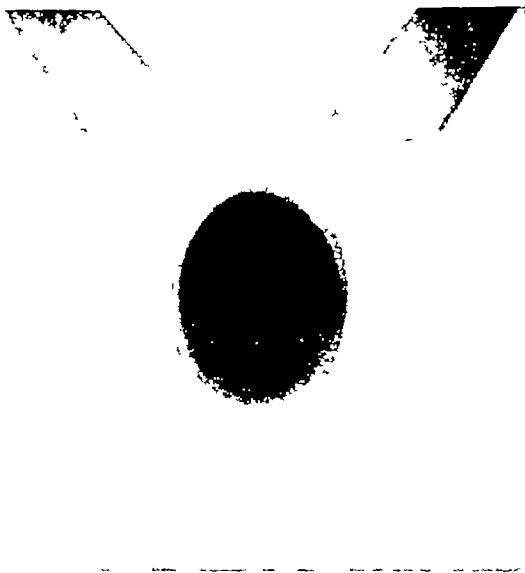


Fig 3 Film placed perpendicularly through center of opposing ports of simultaneous cross radiation apparatus. Note density of beams at the top of the phantom, gradually diminishing and again increasing at the area of cross radiation. The oval shadow is produced by beams entering at right angles. Also note the fading of x ray beams beyond area of cross-radiation

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Fig 4 Film placed perpendicularly half way between the four ports. Line represents surface of phantom (or skin area)

of ports of entry (32 or more) through which x-ray beams are brought to converge on any specific area, producing a homogeneous radiation effect. Even in lesions of lesser depth, such as cancer of the breast, there is an advantage in cross-radiation, since the x-ray beams are tangential to the underlying structures and injuries to the lungs, pleura, and the like, such as often occur with perpendicular x-ray beams, are avoided.

Due to technical difficulties encountered with vacuum pumps, the original model described in the first published report was replaced by the present one, which has been in use since 1939. It consists of a shock-proof, oil-filled, lead-lined steel tank containing a 200-kv transformer surrounded by four balanced x-ray tubes. The oil is cooled by a continuous flow of tap water

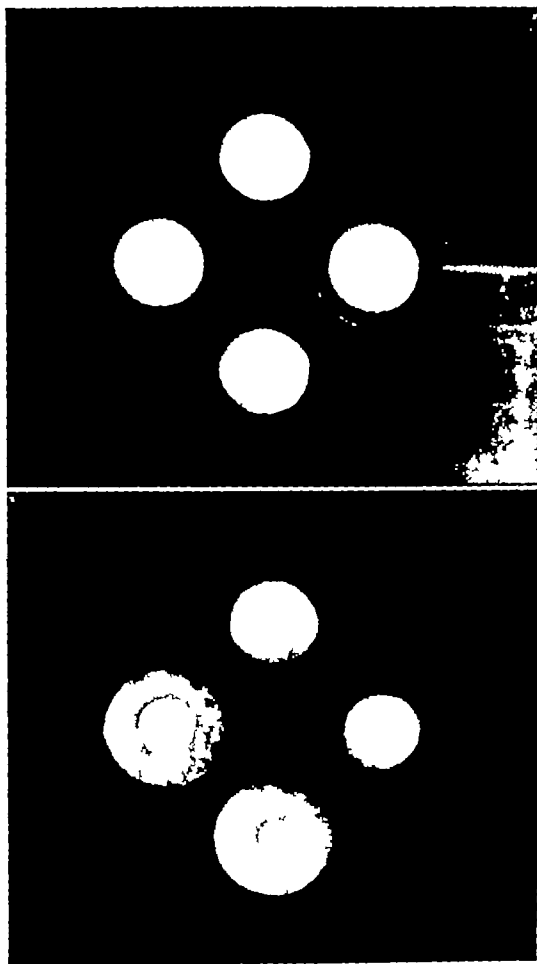


Fig 5 Lead diaphragm encased in steel showing all four ports. In the lower view the size of the fields is reduced by the insertion of lead rings of various sizes

through copper coils which are attached to the tank's inner wall. Since the roentgen rays are confined within heavy steel and lead enclosures, neither primary nor secondary radiation can escape except through the portals in the diaphragm, which are in direct contact with the skin, and, since filtration occurs at the skin, very little secondary radiation is transmitted to the patient. The grounded tube affords protection both to patient and operator.

Changing the position of the openings in the regulating diaphragm makes possible the dovetailing of roentgen-ray beams, which may be concentrated upon a tumor with little cross-radiation outside of the neoplasm. By varying the position of the

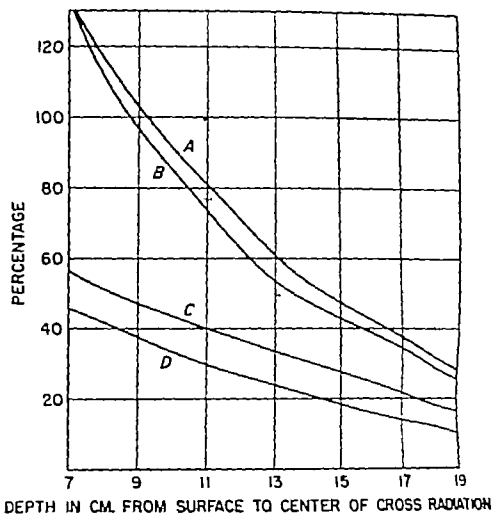


Fig 6 Percentage of skin dose delivered to tumor depth with multiple target apparatus and with conventional target tube

A Multiple target, 200 kv, 5 ma. (each target) 2 mm Cu + 1 mm Al

B Multiple target, 200 kv, 5 ma. (each target) 1 mm Cu + 1 mm Al

C Conventional single target, 220 kv, 15 ma., Thoraeus filter, equivalent to 2 mm Cu

D Conventional single target, 220 kv, 15 ma, 1 mm Cu + 1 mm Al

All curves were obtained through the same phantom and the same surface areas

portals or the position of the patient, one can reach a definite and identical depth through from 32 to 40 ports of entry with little cross-radiation elsewhere.

Each tube filament is regulated individually at the control cabinet, so that the output at all ports can be calibrated uniformly. Targets are arranged at 60 degree angles. A series of heavy lead diaphragms, encased in sheet steel, each of which has four apertures, is calculated to allow the x-ray beams to cross at different depth levels of 1 cm variations below the surface of the skin. The relative position of the openings in the diaphragm determines the level of cross-radiation. The closer the openings are to the center of the diaphragm, the nearer to the surface the rays will cross, the farther the apertures are apart, the deeper the site at which the rays meet.

The target-skin distance is fixed and unchangeable and depends, under all circumstances, upon the distance between the center of the tumor and the skin. On each

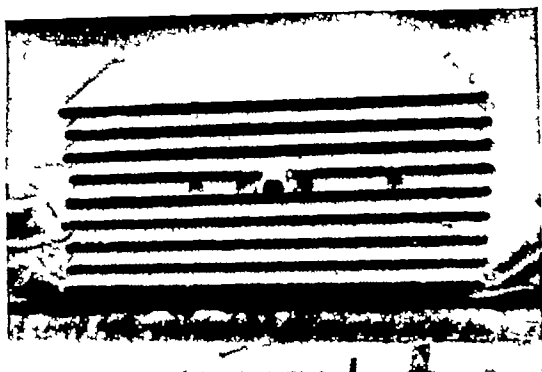


Fig 7 Plaster-masonite phantom with ionization chamber in position

diaphragm is indicated the thickness and kind of filter and the exact target-skin distance. In the center of the diaphragm is a marker which indicates a perpendicular line to the exact center of cross-radiation at various levels.

Because of the variation in the size of x-ray beams at different levels, apertures in the several diaphragms differ slightly in size, so that the area of cross-radiation in the present model is exactly 100 sq cm at all levels. The size of the area can, however, be regulated by a series of lead ring inserts placed in each opening. In irradiating a pituitary gland, larynx, or other small area, intense irradiation can be carried out without exposing too much of the surrounding normal tissue.

The important procedure of locating a lesion cannot be delegated to a technician or to an inexperienced assistant, but must be carried out by the radiotherapist himself. The exact distance from the center of the tumor to the skin surface in the various positions (*i.e.*, anteroposterior, postero-anterior, right and left lateral, etc.) having been determined, measurements are taken from anatomical points such as the ensiform process, symphysis pubis, iliac spines, umbilicus, and the like, and are marked on the surface. Positioning is thus simple and accurate. After determination of the total dose and the daily depth dose, any trained technician can carry out the treatment easily and precisely. The patient is placed tightly against the diaphragm with

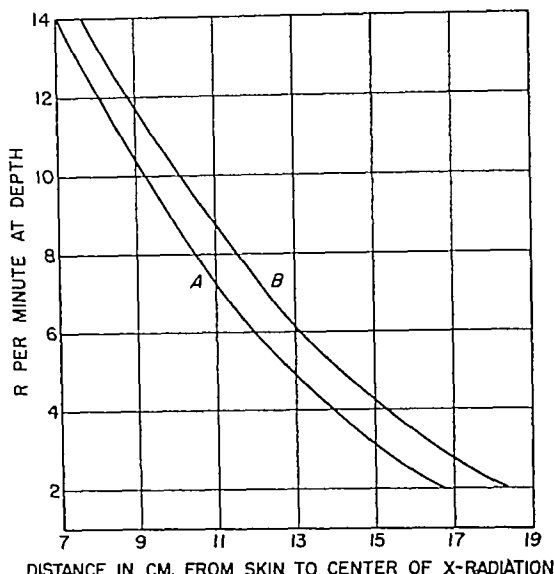


Fig 8 Almost exactly parallel curves obtained in measurements at depth through living tissues (A) and through plaster masonite phantom (B). Cross radiation 200 kv, 1 mm Cu + 1 mm Al.

the center of the mass to be treated (marked on the skin) located directly under the center indicator. A diaphragm with the proper depth designation is selected, and the desired filter is inserted above the diaphragm.

In calibrating depth dosage at the level of cross-radiation, I constructed a practical phantom by using alternate layers of plaster board (1 cm thick) and masonite (1.2 cm thick). Curves thus obtained have been found to parallel almost exactly measurements taken on a series of patients of varying sizes and thicknesses. The phantom is made up of loose 18 × 18-inch square boards, one pair having a slot to accommodate the ionization chamber. On the top board is marked the exact position of the chamber, which should always be in the center of cross-radiation when the proper diaphragm is used. Exception to the dosage chart is made in the treatment of chest lesions because of the decreased density in lung tissue.

By removing the diaphragms from the apparatus, whole body radiation can be accomplished in leukemias and other conditions where teleradiation or spray radiation has been found to be of value.

MULTIPLE PORT CROSS-RADIATION WITH 200 KV CALIBRATION BY PHANTOM SHOWING DOSAGE AT VARIOUS DEPTHS AND PERCENTAGE DEPTH DOSE AS COMPARED TO SKIN DOSE

Distance		Filtration			
Target to Field, cm	Skin to Field, cm	2 mm Cu + 1 mm Al Depth Dosage		1 mm Cu + 1 mm Al Depth Dosage	
		r per min *	% of skin dose	r per min *	% of skin dose
41 9	At surface	7	100	11	100
48 9	At 7 cm	9 5	135	14 5	131
49 6	8	8	114	12 5	109
50 5	9	7 25	103	11	100
51 1	10	6 5	93	9 5	86 75
52	11	5 75	82 14	8	72 75
52 6	12	5	71 4	6 75	61 8
53 5	13	4 25	60 7	5 75	52 75
54 1	14	3 75	53 6	5 25	47 75
55	15	3 25	46 4	4 75	44
55 8	16	3	42 85	4 25	38 65
56 5	17	2 75	39 28	3 75	34 5
57 2	18	2 25	32 14	3 25	29
58 1	19	2	28 57	3	27 5

* With back-scatter

The following reports are presented as illustrative of results obtained by simultaneous cross-radiation in a variety of cases of advanced cancer

CASE REPORTS

The first case illustrates the advantages and almost dramatic effects of large depth doses of x-rays given daily

CASE I Charles P, 11 years old, was sent to the hospital on March 17, 1946, for diagnosis. He was cyanotic and unable to lie down because of shortness of breath. A chest film showed a large mass in the mediastinum, filling about one-half of the chest cavity. The temperature was 100°, the pulse 90, the blood count essentially normal, and urinalysis negative. Cervical, axillary, and inguinal lymph nodes were palpable but small.

A tentative diagnosis of Hodgkin's disease was made and irradiation was begun on March 19. A calculated tumor dose of 200 r was administered daily for ten days, totalling 2,000 r. The skin dosage was 165 r at each port, measured in air with back scatter, totalling 660 r each day, or 6,600 r for the ten treatments.

During the night following the first treatment the patient's condition was critical. He showed some improvement the next day, and continued to do so. On the fifth day he was able to lie down, and on the tenth day he was out of bed, walking and apparently in normal health. Physical examination showed no symptoms of respiratory embarrassment. A roent-

genogram taken the same day revealed a complete disappearance of the mass.

Two months later the patient was brought back to the hospital, a very sick child. A chest film showed no recurrence of the tumor, but the blood picture had undergone a marked change, showing 3,000,000 red cells and 240,000 white cells, mostly lymphocytes, with a great number of lymphoblasts. A definite diagnosis of leukosarcoma was now made. Blood transfusions and other supportive measures were without effect, and death ensued two weeks later. The white cell count on day of death was 400,000.

CASE II Mrs B G, white, age 68 had discovered a lump in her left breast eight months previously but did not seek medical aid until she felt a painful mass in the left axilla. Meanwhile, her breast became ulcerated. She consulted a surgeon, who thought that the lesion was beyond surgical help and referred her for palliative x-ray therapy.

Simultaneous cross radiation was given from July 18, to Aug 5, 1944 with a daily average of 300 r, as determined for the center of the tumor. The total dose was 4,800 r at depth over a period of three weeks, omitting Sundays. Radiation was given through four ports with an average daily skin dose of 880 r, covering the axilla, supraclavicular and infraclavicular areas, and a total dose of 12,500 r. Radiation factors were 200 kv, 20 ma, 1.0 mm Cu + 1.0 mm Al filtration, 50 cm target skin distance. The apertures were 12 cm in diameter, the average time per treatment was 22 minutes. A mild epithelitis developed which cleared completely within three weeks.



Case II July 18, 1944



Case II October 20, 1944



Case V Aug 5 1942



Case V Nov 6, 1942



Fig 9 Case I Mediastinal tumor (leukosarcoma) A Roentgenogram made March 17 B Roentgenogram made March 29, ten days after irradiation was begun

There is no evidence of recurrence at present, although the time elapsed is too short to predict the outcome. The patient feels perfectly well and is able to do her housework. The axillary nodes have receded and are no longer palpable. (See color plate.)

CASE III Miss N E, white, age 51, was referred to us by a surgeon whom she had consulted because of a mass in the left axilla, about 10 cm in diameter, which gave her pain and discomfort. Upon examining the breast, a smaller mass, about 4 cm in diameter, was found close to the nipple in the upper and outer quadrant.

Radiation therapy was started Aug 20, 1941, and was carried through daily, except Sundays, until Sept 22. The breast and axilla each received 3,000 r, as estimated at tumor depth, and approximately 9,500 r measured at the skin with back-scatter. Radiation factors were 200 kv, 4 ports, each 12 cm in diameter, distance 50 cm, 1.0 mm Cu + 1.0 mm Al filtration, 5 ma each target, average treatment time 22 1/2 minutes.

Both masses have completely disappeared. There was a slight epithelitis because of unavoidable overlapping. Over five years have passed and there are no signs of recurrence, nor are there any lung changes.

CASE IV Mrs D L, white, age 33, married, with two children, gave a history of a lump in the left breast in 1938, for which mastectomy was performed. The pathological findings are not known.

In 1940, a mass appeared in the right breast, with small palpable nodes in the right axilla; several small nodules were found in the scar of the left breast, which had been amputated eighteen months before. Biopsy revealed metastatic adenocarcinoma in the nodules in the scar tissue and in the mass from the right breast.

Radiation therapy was begun Dec 18, 1940, and carried through until Dec 31. Each breast received 2,000 r at tumor depth, and the same dose was given in the axilla and supraclavicular regions. A second series was begun on May 21, 1941, and carried through to June 4. The dose was the same as in the first series. Between the two treatment periods, i.e., Jan 23 to Feb 2, a sterilizing dose of radiation was administered to both ovarian regions. Each ovary received 1,850 r, as measured at depth, or 4,560 r as measured on the skin.

Five years have passed, and the patient is in excellent health, with no signs of recurrence or any pneumonic changes.

CASE V Mrs D C, white, age 55, was sent to the hospital Aug 5, 1942, with hemorrhage from the cervical stump and a history of loss of weight and strength. The body of the uterus had been removed three months earlier. On inspection, the cervix was found to be fixed, very vascular, and rough and granular in appearance. A biopsy was done, and a diagnosis of cancer, grade 3, was made. Radiation therapy was advised.

Multiple port cross radiation was started on

wall, and involvement of the rectum. The patient required daily purgation and enemas. She refused a colostomy, which seemed inevitable. Treatment was administered daily from March 28 to May 1, 1944, except Sundays, averaging 150 r to the tumor. Measured *in vivo*, the dose totalled 3,000 r to the center of tumor, filtered through 1.75 mm Cu + 1.0 mm Al. There was a slight bronzing of skin at the end of the treatments, as well as slight nausea, which was easily controlled.

Because of the extensive involvement, small daily doses of spray radiation were given to the entire abdomen with the hope of producing an inversive reaction in the lymphatics. Following treatment, there was no further clinical manifestation of neoplastic involvement of the abdominal structures. This empirical procedure was based upon observation of a number of cases where palliative treatment had been given to bone metastases from a carcinoma of the breast, and where involution of axillary nodes had been noted, even though the breast and axilla were out of the range of the x-ray beams.

A roentgenogram prior to treatment showed a narrowing of the rectum. Six weeks later, the filling defect had disappeared, as had the mass in the vaginal wall. The bowels moved normally and the cervix became rounded and took on a normal appearance.

The patient lived in fair comfort for about one year and died from a metastatic lesion of the brain.

CASE VIII C. D., male aged 40, was referred on March 1, 1941, because of a swelling at the angle of the right mandible. The mass had been developing for about one year, but had enlarged rapidly the month preceding admission. The patient had difficulty in opening his mouth because of the pain and swelling and had been subsisting on liquids, chiefly milk, for about three weeks. The tumor was hard and firm, and a diagnosis of carcinoma of the parotid gland was made.

Radiation with the multiple port tube was started on March 1, 1941, and carried through until April 9. A second shorter series of treatments, beginning May 5 and continuing daily to and including May 12, 1941, was also administered. The daily dosage was 150 r to the center of the tumor through 4 ports, with 2.0 mm Cu + 1.0 mm Al filter, 200 kv, 5 ma. The total dose was 3,600 r.

The tumor receded long before the completion of the first series and, after the second series, completely disappeared. At the present time, five years later, the patient is well and shows no sign of recurrence.

CASE IX Mr. A. G., age 72, came to the hospital on July 29, 1941, with a diagnosis of inoperable carcinoma of the prostate gland. He wore a retention catheter and a portable urinal strapped to his thigh. The gland was large and nodular.

Palliative x-ray therapy was started on the day

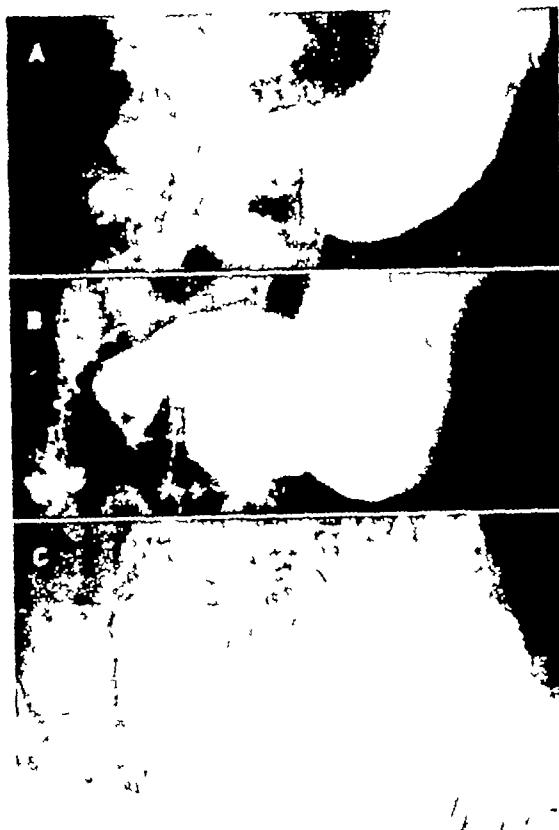


Fig 11. Case X. Carcinoma of the stomach. Successive views, Oct. 18, 1940 (A), Feb. 4, 1941 (B), and April 16, 1941 (C).

of admission and was administered for eighteen days, omitting Sundays. The dose was 200 r daily, measured at depth. The superficial skin dose was 165 r at each port, totalling 660 r per treatment. The total depth dosage in the first series was 3,600 r calculated at tumor depth, total skin dosage 12,000 r including back-scatter. By mid-September the prostate was greatly diminished in size and the patient was advised to discard the retention catheter. It was found that he had control of the sphincter and was able to void voluntarily.

A second series of treatments was given between Sept. 29 and Oct. 6, inclusive, totalling 1,600 r at tumor depth, or 5,280 r distributed over the skin. The ports of entry numbered 40—8 anteroposterior, 8 right lateral, 8 postero-anterior, 8 left lateral and 8 perineal.

The patient lived in comfort until February 1943 when he died of pneumonia.

CASE X E. L., white male, age 62, had stomach trouble for a number of years. He had recently vomited blood and coffee ground material, had lost 14 pounds in four weeks, and was dehydrated. X-ray examination showed a large filling defect in the prepyloric region. The diagnosis was probable cancer of the stomach. The attending surgeon suggested gas-

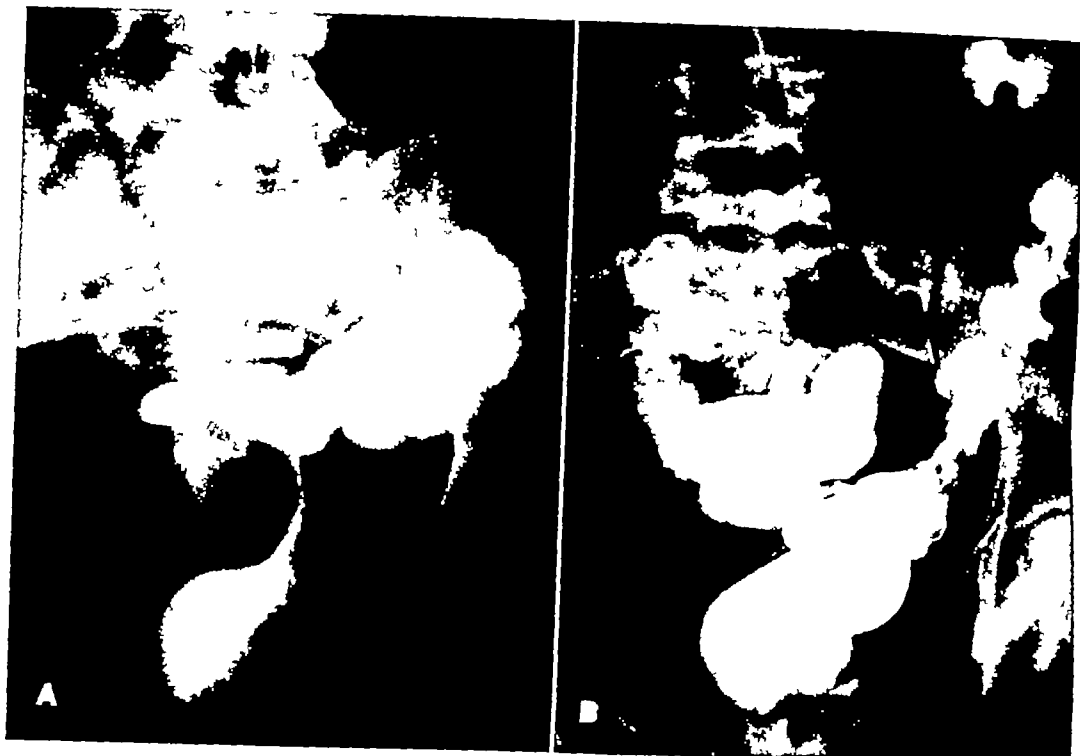


Fig 10 Case VII Involvement of the rectum secondary to carcinoma of the cervix. Views made on March 28 (A) and May 15 (B) before and after roentgen therapy, respectively

Aug 10, 1942, and was carried out daily, except Sundays with a rest period between Oct 31 and Nov 8 and another between Nov 19 and Dec 12. Forty two treatments were given, averaging 180 r at tumor depth, totalling 7,615 r. The skin dosage was distributed over 40 fields, *ie*, 8 anteroposterior, 8 postero anterior, 8 right lateral, 8 left lateral, and 8 perineal. The total skin dose measured in air, with back scatter was 44,480 r.

The skin reaction was very slight. There was some disturbing reaction in the colon and the urinary bladder, which necessitated the rest periods mentioned above. The patient made an uneventful recovery and is in apparent good health at the present time. Photographs of the cervix, taken before and after treatment (see color plate), show remarkable results.

CASE VI Mrs O B, white age 49, was admitted to the hospital Feb 23, 1943 because of severe uterine hemorrhage of about one month's duration. On examination, we found the body of the uterus about the size of a large grapefruit. Through the cervical os protruded a large mass which was partly necrotic and very vascular. The biopsy report was grade 4 carcinoma. The case being considered hopeless, x ray irradiation was recommended for control of bleeding. Meantime, supportive treatment was given in the form of blood transfusions, medication and good nursing care.

Simultaneous cross radiation was commenced on Feb 23 1943 and continued daily, except Sundays, until March 31. During that period, the patient received 6,814 r at center of tumor, with a skin dose of 50,816 r distributed through 40 separate ports. On examination at the end of treatment, it was surprising to see smoothing and regression of the tumor which had been protruding through the cervical os. The cervix was inflamed.

At this time the patient had regained some strength and weight and had begun to feel better. On May 25 she was brought back to the hospital because of recurrent hemorrhage. A second series of cross radiation was started and continued daily until June 4. Eight treatments were administered totalling 2,200 r at tumor depth or 8,800 r distributed through 40 ports over the skin.

Death occurred suddenly on June 5 from a coronary thrombosis.

CASE VII Mrs M L white age 54 had passed through the menopause six years previously. One year before admission bleeding had begun and was treated by intra uterine radium application for 48 hours (dose unknown). Hemorrhage ceased for six weeks and then recurred. Hysterectomy was suggested but refused, and the patient was referred for palliative radiation treatment.

Examination revealed total erosion of the cervix and extension of growth to the posterior vaginal

wall, and involvement of the rectum. The patient required daily purgation and enemas. She refused a colostomy, which seemed inevitable. Treatment was administered daily from March 28 to May 1, 1944, except Sundays, averaging 150 r to the tumor. Measured *in vivo*, the dose totalled 3,000 r to the center of tumor, filtered through 1.75 mm Cu + 1.0 mm Al. There was a slight bronzing of skin at the end of the treatments, as well as slight nausea, which was easily controlled.

Because of the extensive involvement, small daily doses of spray radiation were given to the entire abdomen with the hope of producing an inversive reaction in the lymphatics. Following treatment, there was no further clinical manifestation of neoplastic involvement of the abdominal structures. This empirical procedure was based upon observation of a number of cases where palliative treatment had been given to bone metastases from a carcinoma of the breast, and where involution of axillary nodes had been noted, even though the breast and axilla were out of the range of the x-ray beams.

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The tumor receded long before the completion of the first series and, after the second series, completely disappeared. At the present time, five years later, the patient is well and shows no sign of recurrence.

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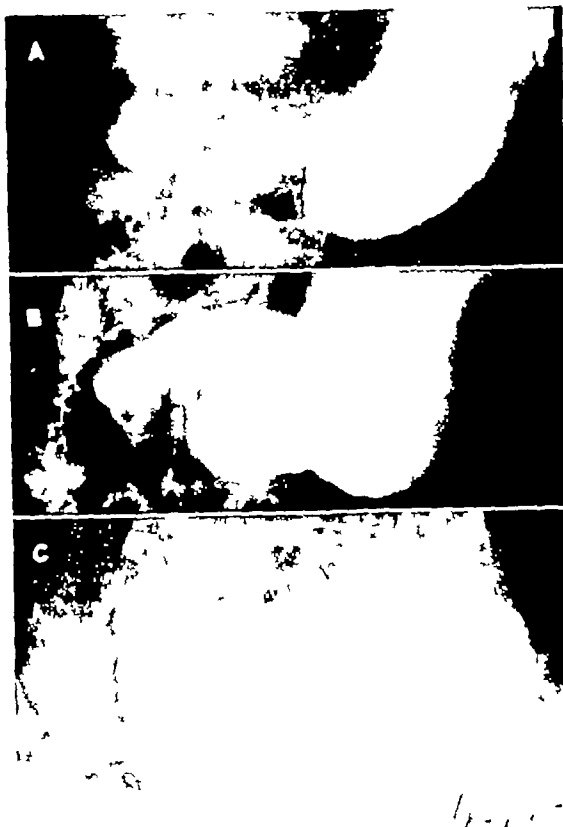


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tric resection, but the patient refused. He was referred for radiation therapy, and two series of treatments were administered.

The first course began Nov 15, 1940, and extended to Dec 9, 3,000 r being given to the center of the tumor through 1.75 mm Cu + 1.0 mm Al. A second series of 2,700 r was administered from Feb 4 to Feb 23, 1941, with the same factors. No untoward effect was noted, beyond a slight bronzing of the skin. The lesion diminished gradually in size, and the patient regained his lost weight. In April 1941, on recheck roentgenography, a very small filling defect was still present, and a third series of irradiation was recommended.

The attending physician objected to further x-ray treatments on the assumption of a possible erroneous diagnosis for as he put it, he had never heard of anyone being cured by radiation and the patient felt quite well at that time. One year later the patient was operated upon for an obstructive lesion and was found to have large metastatic masses in the liver and omentum, which confirmed the original diagnosis.

It is not certain what further radiation treatments might have accomplished in this case but for a brief period, at least, palliative relief was obtained.

CASE XI D A, a 3-year old boy, was brought to the hospital Oct 29, 1940, with a swelling in the right sacroiliac region. Thirty days earlier he had complained of pain in the back, but as there was no swelling or tenderness at that time, the mother attributed his complaints to a sprain. Two weeks later she discovered a tender mass over the right sacroiliac region. An x-ray film at that time showed an osteolytic tumor which, on aspiration biopsy, was diagnosed as sarcoma.

Simultaneous cross radiation was started on the day of admission and continued through Nov 8 by which time the tumor had disappeared entirely. The average daily dose was 150 r estimated at tumor depth, through 1.0 mm Cu + 1.0 mm Al, with 4 simultaneous ports, 200 kv, 5 mm, average time 11 minutes.

A second series of simultaneous cross radiation was administered from Nov 23 to Nov 28 inclusive, with the same factors as above. The total dosage at the center of the tumor was 2,146 r.

Now, six years later, the child appears to be perfectly well and shows no sign of recurrence.

Reviewing the whole series of cases treated from August 1939 to August 1946 by simultaneous cross-radiation, we find that results vary in diminishing effectiveness. In the list below, the most gratifying results are given first.

- 1 Lymphogenous group, including Hodgkin's disease, leukosarcoma, etc
- 2 Adenomas, both benign and malignant, particularly prostatic, salivary gland, and thyroid tumors
- 3 Mammary gland neoplasms
- 4 Uterine tumors, especially adenocarcinomas, to a lesser degree, the squamous type
- 5 Tumors of the bladder
- 6 Gastric and intestinal cancer (gratifying palpation)
- 7 Bone tumors of metastatic origin (A single case of osteogenic sarcoma was treated successfully as reported above)

CONCLUSION

A method of treatment has been described whereby one can administer at depth radiation doses comparing favorably with surface therapy. Lethal doses can be given to malignant tissue with a minimal amount of radiation to normal tissues in the tumor bed. The rate of recovery being more rapid in the latter than in the intensely irradiated tumor cells, fibrils of new connective tissue, blood vessels, and other repair processes are projected from the tumor bed into the tumor proper, replacing the destroyed neoplastic tissue.

114 N Sixth St
Zanesville Ohio

REFERENCE

- LOEBELL M A. Simultaneous Cross Radiation
Am J Roentgenol 39 274-277 February 1938

Erosive Bone Lesions and Soft-Tissue Ossifications Associated with Spinal Cord Injuries (Paraplegia)¹

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Buffalo, N Y

and

WILLIAM G KUHN, Jr, M D

Boston, Mass

DURING THE PAST war large numbers of patients with spinal cord injuries were seen on the neurosurgical services of the specialized general hospitals in the zone of the interior. These injuries were due to direct wounds from high explosive fragments or bullets, or to crushing injuries of the spine associated with violent trauma. With modern methods of therapy, the life span of these paralyzed individuals has been greatly lengthened. In the course of their treatment many complications developed. The commonest of these were malnutrition, decubitus sores, urinary tract calculi, and spastic deformities. The bony prominences adjacent to the decubiti frequently became eroded. In addition, ossifications developed in the neighboring soft tissues. These ossifications and erosions have been of particular interest to us.

Following the First World War, Dejerme, Ceillier, and Dejerme (1, 2) observed the presence of ossifications in the soft tissues, chiefly around the joint capsules and femoral shafts, in 49 per cent of paraplegic patients and described them under the name of "*para-osteo-arthropathies*". They called attention to the lack of development of disintegrative changes of the joint surfaces which commonly occur in the tabetic arthropathies and also pointed out that pathological fractures were very unusual. Erosions of bone adjacent to sores were noted but no descriptions were given. Voss (3) completely reviewed the literature in 1937 and called attention to the development of these ossifications in a variety of diseases of the brain, spinal

cord, and peripheral nerves. He presented the following list of conditions in which soft-tissue ossifications had been observed:

Brain Diseases and Cerebral Hemiplegia

- Epidemic encephalitis
- Progressive paralysis
- Syphilis of central nervous system
- Arteriosclerotic bleeding and thrombosis
- Embolie encephalitis
- Post-traumatic brain lesions
- Brain hemorrhage with intracranial hemangioma
- Cerebral hemiplegia of unknown etiology

Diseases of the Spinal Cord

- Meningocele
- Traumatic section of cord
- Extramedullary tumor
- Myeloencephalitis
- Syphilitic meningomyelitis
- Tuberculous meningomyelitis
- Acute anterior poliomyelitis
- Funicular myelosis with circumscribed thrombosis
- Tabes dorsalis
- Syringomyelia

Diseases of the Cauda Equina

- Compression of the cauda equina

Diseases of the Peripheral Nerves

- Polyneuritis

Recently Soule (4) has described the findings in a group of 62 patients with disease of the spinal cord and cauda equina under the title "*Neurogenic Ossifying Fibromyopathies*".

Roentgenologists assigned to the large general hospitals caring for patients with spinal cord injuries had the opportunity of observing the soft-tissue ossifications and the erosive bone lesions. It seems timely, therefore, to present a description

¹ Presented at the Thirty second Annual Meeting of the Radiological Society of North America, Chicago Ill., Dec 1-6 1946

tric resection, but the patient refused. He was referred for radiation therapy, and two series of treatments were administered.

The first course began Nov 15, 1940, and extended to Dec 9, 3,000 r being given to the center of the tumor through 1.75 mm Cu + 1.0 mm Al. A second series of 2,700 r was administered from Feb 4 to Feb 23, 1941, with the same factors. No untoward effect was noted, beyond a slight bronzing of the skin. The lesion diminished gradually in size, and the patient regained his lost weight. In April 1941, on recheck roentgenography, a very small filling defect was still present, and a third series of irradiation was recommended.

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Fig 1 Well defined round ossifications in the perineum and at the top of the left trochanter, which developed within four months. Both trochanters show moderate (Grade II) erosive changes. This film was made on Jan 31, 1946. No definite bone or soft tissue changes had been demonstrable on Sept 20, 1945.

The patient was injured by a bullet on April 6, 1945, and had a complete paralysis below D-10. Trochanteric and sacral sores developed about two months after the injury. The former tended to progress in size, while the sacral sore showed signs of healing after six months. In November 1945, an unsuccessful attempt was made to repair the trochanteric sores. The patient had mild flexor spasm of the lower extremities. From December 1945, he became progressively more ambulatory in a wheel chair and braces. His general health became better and the sores improved but did not heal completely.

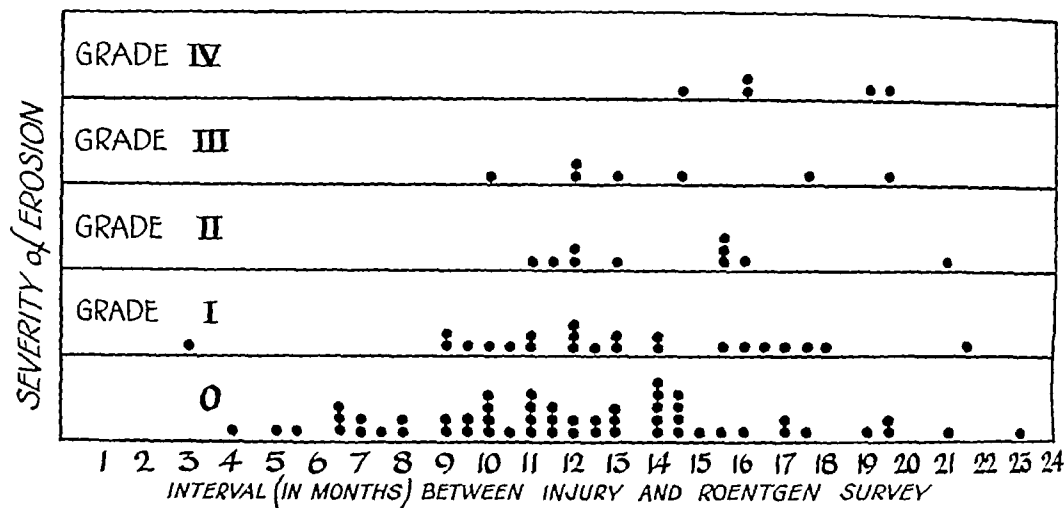
were very striking in some cases. In addition, a few patients had erosions of the ischial tuberosities. The extent of the erosive change in most cases was directly related to the severity, size, and duration of the decubitus sores. Eighty-five per cent of this series had sores over the sacrum, the trochanters, or the ischial tuberosities.

We shall first review the soft-tissue ossifications as they have been described previously and as they have been observed in our patients, and then present the erosive lesions with a description of the pathological findings.

Since the greatest number of roentgen studies in this series were made on an average of at least twelve months after the injury to the spinal cord, the ossifications were well developed and we did not

see any early lesions. In all probability, the precursor of the ossification is the laying down of flocculent, nebulous, or streaky amorphous calcium. Brailsford (5) has reported the presence of amorphous, flocculent calcification around the elbow in a case of hematomyelia of the cervical cord two months after injury. In another case of his in which there was known injury to the elbow joint, immediate radiographic examination revealed no changes, yet twenty days later there were woolly calcium deposits about the joint, and five weeks later well defined ectopic bone. As full development occurs, the bone may have compact or spongy components, or both, and may be in the form of small irregular fragments, in spicules, or in large irregular masses (Fig 1).

Ossifications are most often seen in the



Erosive changes in paraplegia frequency chart

of the roentgen findings since the detection of these lesions is primarily roentgenologic. It should be emphasized that the soft-tissue ossifications are not specific for spinal cord injuries but may develop in a great variety of diseases affecting the nervous system.

One hundred and nine cases of paraplegia were originally studied roentgenographically. Ten patients, however, upon completion of the survey, had been transferred to other hospitals and their films and records were not available for final compilation, so that the present report is actually based upon 99 cases. These have been arbitrarily divided into four groups depending upon the severity of the erosive bone change (Table I). The length of time

TABLE I CLASSIFICATION OF CASES ON BASIS OF EROSIIVE BONE CHANGES

Erosion	Erosive Bone Lesion	Soft Tissue Ossification	Total Cases
0	0	4	54
Grade I	23	17	23
Grade II	10	10	10
Grade III	7	7	7
Grade IV	5	5	5
	45	43	99

from the date of injury to the date of the survey is well illustrated in the accompanying frequency chart. The average was twelve months or more. The earliest de-

velopment of any single bone lesion or soft tissue ossification is not known for any case of this series.

The roentgen survey included stereoscopic films in the anteroposterior projection of the lower lumbar spine, pelvis, and hips in all cases. Additional views of the knees, ankles, and heels were obtained in about 25 per cent of the group.

Of the 99 patients, 45 showed erosive bone changes aside from osteoporosis. Forty-three patients revealed soft-tissue ossification either contiguous with or apart from the skeleton. In only 4 cases with soft-tissue ossifications were there no associated bone changes. It is likely that if the study had been more complete, *ie*, if every part of the body below the level of the cord lesion had been studied, the incidence of soft-tissue ossifications would have been higher. In this series the percentage lies between that reported by Dejerine, Ceillier, and Dejerine, 49 per cent, and that reported by Soule, 33 per cent.

All of the previous reports of soft-tissue ossifications associated with lesions of the central nervous system stress the absence of accompanying bone lesions aside from the osteoporosis of the involved parts which invariably follows the disuse. In conducting our survey, we were impressed by the erosions of the trochanters which



Fig 4 Large bony mass extending downward and posteriorly from the ischial tuberosity

This patient was injured on Nov 11, 1944 sustaining a complete paralysis with the level at D-11. His general condition has always been good and no decubitus sores have ever developed. The large mass of mature cancellous bone was noted during the survey and had not been suspected clinically.

vicinity of the larger joints, especially the hip and the knee. They may occur in muscles, tendons and sheaths, in ligaments, in the joint capsules, or be attached to the periosteum. In the region of the hip they are commonly seen in the lower part of the capsule or they may be extracapsular (Fig 2). In many cases they seem to arise from the acetabular lips. They are commonly seen at the tops of the trochanters, seemingly contiguous to the trochanteric bone, and are most likely formed at the sites of the muscle attachments. About the knee they are most frequently found along the medial side in the region of the medial collateral ligament, but as a rule they are somewhat more extensive than is usual in Pellegrini-Stieda's disease. In

some cases they may occur in the fascial planes or deep muscles of the thigh, usually on the medial side or in the buttocks (Fig 3). When in the fascial planes they are arranged in spicules, in the muscle they may present themselves as large masses of mature cancellous bone (Fig 4). When the ossification is massive, it may completely ensheath a large joint and make it immobile.

The French authors (1, 2) who have the largest series have stressed the fact that the periosteum adjacent to the ossifications shows no changes. Even though the new bone formation is extensive and contiguous to the periosteum, it does not affect the periosteum or arise from it. It may be lightly attached to it in one or two areas.

The ossifications usually form within a

Fig 3 Streaky ossifications in the deep fascial planes of the thigh medial to the lesser trochanters and at the tops of the greater trochanters. The greater trochanters show bilateral erosive changes (Grade II).

This patient was injured on January 1, 1945 by a shell fragment which completely severed the cauda equina at L-1. Two months later bilateral trochanteric sores appeared and they gradually increased in size. The general nutrition was poor and there was severe pain. In July 1945 a cordotomy was done for relief of pain. This lasted for three months and there was some general improvement. The pain then recurred and the general condition regressed. The decubiti have persisted. The patient has never been ambulatory.



Fig 2 Well defined ossifications below the femoral necks and at the superior acetabular lips. There are faint ossifications at the tops of the trochanters and early (Grade I) erosive changes of the trochanters.

This soldier sustained a fracture of C 5 on Aug. 17, 1944 following a driving accident. He had a complete paralysis with the level at C 6 and C-7. Sacral and trochanteric sores developed about four weeks after injury. The sacral sores healed in about three months but those over the trochanters were still present in January 1946. The patient's general health has always been good and he has been very active in a wheel chair. Due to the limitation of use of his upper extremities he has never been up in braces. There is moderately severe flexor spasm of the legs. [Legend for Fig 3 on opposite page]



Fig 8 Ossifications below the acetabula on both sides. The one on the right is continuous with the superior lip of the acetabulum. There are Grade II erosions of both trochanters.

This patient was injured on Feb 4, 1945, by a bullet, which produced a complete paralysis with the level at D 8. Decubitus sores developed over both trochanters nine months after injury. They became progressively worse, with a fair degree of surface infection. The sores were closed surgically after they had been present for six months. The patient's general condition has always been poor.

to the erosion and flattening, the impression is gained that there is a reshaping or moulding of the upper femoral shaft in the region of the erosive process. The bone, instead of being just flattened, has a curvilinear contour with pointing of the superior portion of the uneroded trochanter. The pointed portion is at the site of muscle attachments, and muscle pull probably plays a role in its formation. Usually there are, in addition, ossifications in the soft tissues above the pointed top of the trochanter and between it and the ilium (Fig 8).

Evidence of healing of the erosive process is noted when the outer contour of the bone becomes more sharply outlined. Where the healing is more extensive, there may be bony proliferation, either shaggy or smooth. The outer curve of the trochanter may be restored to some degree as a smooth excrescence or it may be quite

shaggy, similar to the irregular repair seen in some fractures or in cases of arrested osteomyelitis (Fig 9). It may be that as the healing stage is followed for greater lengths of time more cases will show evidence of proliferative repair of the surface.

Some cases have shown other changes which might be considered as complications. One patient with very severe erosive changes of the trochanters and ossifications in the soft tissues had a subcapital fracture of the neck of the left femur from severe flexor spasm. The type of fracture is similar to that described by Batt and Hampton (7) in tabes.

In another case there was a subluxation of the right hip joint which was associated with severe spasticity. An additional case showing severe erosive changes presented shaggy bony periosteal proliferations of the femoral shaft below the level of the erosions, of the type usually seen when



Fig 5 Complete paraplegia with the level at C-7. Note the well developed ossifications of the intercostal muscles

few weeks or months of the onset of the spinal cord injury. In only one case was late development observed, and this occurred two years after the injury. After they have assumed a mature trabecular pattern, the ossifications tend to remain constant in appearance, without increase in size or density. Additional centers do not develop adjacent to the older ones. This is the rule in the paraplegics where the nerve lesion is constant and non-progressive. However, in progressive diseases like tabes or syringomyelia, new centers of ossification may appear. On the other hand, in myositis ossificans due to direct trauma the ossifications, when fully developed, tend to regress. This regression is not observed in those ossifications which form under the influence of neurogenic disorders.

The ossifications are usually parallel or oblique to the shafts when they are in the muscles and should not be confused with the new bone formation of sarcoma, which, as a rule, is perpendicular to the shaft. They usually extend in the direction of the muscle fibers in which they are located (6) (Fig 5).

Those soft-tissue ossifications which form following lesions of the spinal cord are never seen above the level of the lesion.

The erosive bone changes may be early or late. The earliest erosive change to be noted is a loss of the cortex of the greater trochanter without any reactive change of the underlying bone. Although the cortex in this area is normally thin, it is usually sharply defined in the roentgenogram. With the loss of cortex, the bone surface becomes roughened and slightly shaggy in appearance. Twenty-three of our cases showed this early change and 17 of these had associated ossifications in the soft tissues. Most of these were adjacent to the tops of the trochanters and extended above them for a few millimeters (Fig 6).

As the loss of bone becomes greater and the lesions increase in severity, the trochanter loses its normal outward bulge and seems to extend upward in a straight or curved line, flush with the cortex of the femoral shaft directly below. This flattened appearance is due to complete loss of the trochanteric bulge (Fig 7).

In the more advanced cases, in addition



Fig 6 Ossifications below the acetabula on both sides. The one on the right is continuous with the superior lip of the acetabulum. There are Grade II erosions of both trochanters.

This patient was injured on Feb. 4, 1945, by a bullet, which produced a complete paralysis with the level at D 8. Decubitus sores developed over both trochanters nine months after injury. They became progressively worse with a fair degree of surface infection. The sores were closed surgically after they had been present for six months. The patient's general condition has always been poor.

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Fig 7 Grade IV erosive changes of the trochanters. Note the moulding of the outer aspect of the left femoral shaft.

The patient was injured on July 8, 1944, with complete paralysis below D-4. The sacral sores healed in ten months but the trochanteric sores were still unhealed in January 1946. There has been a marked degree of flexor spasm and pain. A tractotomy was performed in December 1945, but this was unsuccessful and the spasm is still severe. The patient became fully ambulatory in a wheel chair in January 1946 and ambulatory in braces a month later. His general condition has improved but at the time of ambulation in braces the sores were still unhealed.

there is infection of the soft tissues adjacent to the bone. In this instance there was extensive purulent infection of the sores and the deeper tissues of the thighs (Fig 10).

In summary, the distinctive skeletal features as they are noted in the roentgenograms are, first, erosive changes leading to loss of the normal contour of the trochanters with flattening, followed by reshaping or moulding, and later repair of the eroded surface with formation of an abnormal contour by proliferative or exuberant bone. Secondly, and just as striking as the bony change, is the complete lack of any joint surface involvement or diminution of the joint space. All cases show osteoporosis of varying degrees.

There was no autopsy material available for study. In order to evaluate the exact nature of the erosive process, biop-

sies of trochanteric bone were obtained from 10 patients who were to have secondary closures. By cutting through the granulation tissue into the underlying bone, wedges of bone were obtained with an osteotome. These went to a depth of 1.0 to 1.5 cm. In one case, a small fragment of bone lying loose in the granulation tissue was studied.

Sections were made and these were reviewed by Dr. Henry L. Jaffe (8), whose description is as follows:

"All of the tissue slides show extensive subacute and chronic infection of the soft tissues overlying the bones and extension of the infection to at least the superficial portion of the bone. The involvement of the bone itself is manifested in several ways and to several degrees. The mildest degree of involvement is registered in increased vascularization of the more super-



Fig 8 Extensive (Grade IV) erosive changes of both trochanters. Note the complete loss of the left trochanteric bulge and the appearance of moulding of the outer surface. There are extensive soft-tissue ossifications at the tops of the trochanters on both sides and at the top of the right iliac crest. Note those below the right lesser trochanter.

This patient was injured on Oct 7, 1944, by a shell fragment which caused a complete lesion at D-6. Sores over the sacrum and trochanters developed one month later. Two months after injury skin grafts were attempted on the trochanteric sores but they were unsuccessful. The patient was left on his back during this time and flexion contractures of the legs developed. The sacral decubitus increased in size. In July 1945, a pinch graft was attempted on the trochanteric sores but was only 25 per cent successful. The flexion contractures persisted, and a bilateral hamstring tenotomy was performed but was unsuccessful. This was later repeated and at that time it was found that the sciatic nerve and blood vessels of the lower extremities were bound up in scar tissue. They were mobilized. The patient has been up in a wheel chair since June 1945 but has never been ambulatory in braces. The sacral sore is now healed and the trochanteric sores are minimal in size.

ficially placed spongy marrow spaces, and some inflammatory resorption and atrophy of the osseous tissue. From this mild stage, there is a gradual step-up in various specimens to extensive low-grade inflammatory invasion of the marrow spaces characterized by fibrous and vascular tissue filling the marrow spaces, which have become enlarged. In this tissue, some inflammatory cells are seen, most of which are mononuclear cells. Concomitant with encroachment on the marrow spaces by this inflammatory fibrovascular tissue there are progressive atrophy and resorption of the osseous tissue proper. Finally, in some of the sections, one notes actual ac-

tive osteomyelitis with extensive necrotization of the osseous tissue and even what amounts to potential sequestrum formation" (Fig 11).

What is the sequence of events in these patients which allows the pathological change to develop? Marked weight loss with accompanying soft-part atrophy becomes evident soon after the spinal cord injury. The commonly complicating decubitus sore also forms within a short time. The weight loss, the atrophy of the soft parts, the development of the decubitus with a low-grade infection, the anorexia and digestive disturbances are all clinical evidences of a malnourished state. Their

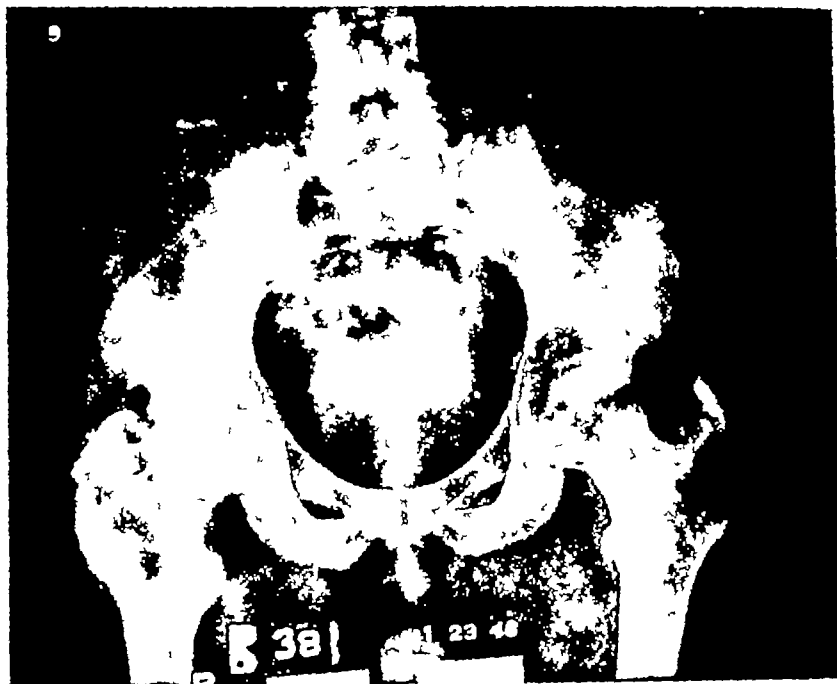


Fig 9 Good example of proliferative repair on the right following the healing of trochanteric sores by secondary closure.

This patient was injured on Aug 20, 1944, with a complete paralysis below D 7. Sores over the sacrum and both trochanters developed three weeks after injury, increasing in severity until February 1945. They then remained static in spite of partial ambulation. An attempt at closure was made in July 1945 but was unsuccessful. Closure was accomplished in September 1945. The patient became completely ambulatory in braces in November 1945 and his general condition has improved markedly. Rather severe flexor spasm of the lower extremities is still present.

correction and the restoration of adequate nutrition constituted one of the most difficult problems in the general medical care of these patients. It was observed that when the nutrition was improved the sores healed more easily or, if secondary closures were necessary, they were more successful (9). It seems quite probable that without the active medical and nursing care given to these patients in order to restore, maintain, or improve their nutrition, many would not have survived. Since they did survive, even in the presence of the severe sores with low-grade infections, the extensive erosive bone lesions which had not before been observed roentgenographically have developed.

It may be stated categorically that the most striking lesions have occurred in the patients whose decubitus sores persisted for the longest periods of time. With the

development of the sore, the marked soft-part atrophy over the trochanter, and the routine in which the patient is turned from side to side, so that he is lying first on one trochanter and then on the other, direct pressure is exerted on the outer aspect of the trochanteric bone. The periosteum is soon affected by this pressure and devitalized, exposing the cortex to the low-grade surface infection. The presence of the sore and the infection produces a local hyperemia. Following treatment, the sore may become relatively clean, with a granulating surface, but the hyperemia persists. The hyperemia and the infectious process lead to absorption of the surface trabeculae, which becomes greater and more extensive as long as the sore remains unhealed. The extent of the erosion and the extent of the fibrovascular reactive change in the bone marrow are dependent



Fig 10 In addition to the erosions this case illustrates the usual type of shaggy periosteal proliferation secondary to infection. This was the only case in the series with this type of periosteal proliferation.

The patient was injured in November 1944, by a shell fragment, which caused an incomplete lesion of the cauda equina. He was in good condition when he entered the hospital but decubitus sores appeared five months after his injury. In February 1945, his nutritional state began to decline in spite of all therapeutic procedures, as repeated transfusions, intravenous amino acids, amigen, concentrated albumin, and plasma. The sores on the hips became worse. The patient has never been ambulatory in a wheel chair or braces. Dependent edema and ascites were noted when the hypoproteinemia was severe. The sores and surrounding tissues of the hips and thighs were heavily infected and purulent at all times. There was moderate adductor spasm.

upon the degree of hyperemia and infection.

In this series of cases there were no joint lesions suggestive of the neuro-arthropathies. Although arthropathies do develop in non-weight-bearing joints such as are seen in the elbow and shoulder in tabes and syringomyelia, it must be emphasized that the joints in paraplegia are not subjected to repeated trauma, as there is loss of motor control as well as sensation. In addition, in the recumbent position the joints of the lower limbs are non-weight-bearing. However, in the general treatment of these patients one of the ultimate goals was to make them ambulatory in braces. This was attempted as soon as their clinical condition permitted. An additional survey

was made of 50 patients who were ambulatory for various periods up to six months, most of them for at least four months. No disintegrative lesions suggestive of an arthropathy were observed.

The only arthropathic change that has been observed is in the one case with a subcapital fracture due to severe flexor spasm. Here the femoral head is intact, but there are loose bony fragments lying free in the capsule, and the appearance is similar to that of a neuro-arthropathy (Fig 12).

It is interesting to speculate whether arthropathies will develop in the ambulatory patients. It may be that, as they become more and more ambulatory, changes will be seen, since factors such as weight-

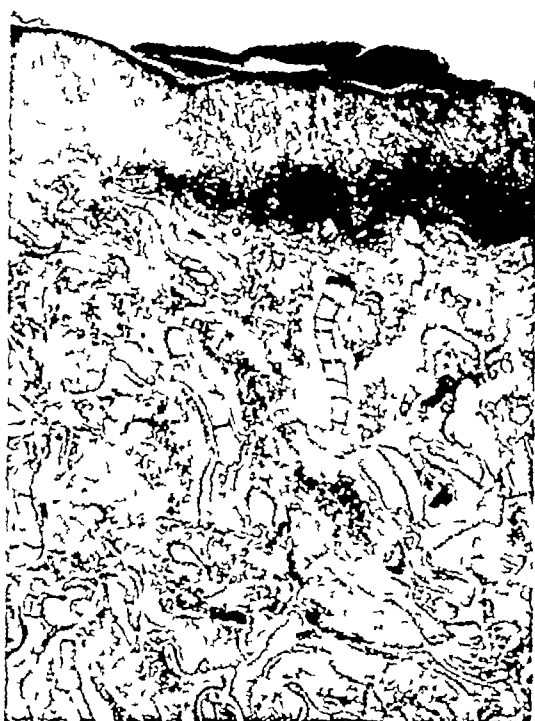


Fig 11 Low power photomicrograph of biopsy specimen showing the characteristic pathological changes. Note the granulation tissue overlying trabeculae in various stages of resorption. The cortex is completely gone. The fatty marrow has been replaced by fibrovascular tissue.

bearing and anesthesia which favor the development of an arthropathy are present. With ambulation the joints will be exposed more frequently to trauma, even though the limbs are protected by braces. It will also be interesting to observe whether there will be any atrophy of bone such as occurs in the metatarsal heads in anesthetic leprosy. Here there is no infection, but the heads and shafts are subjected to direct pressure in the absence of sensation. They disappear while the phalanges remain (10). Further follow-up on these patients at stated intervals would seem to be indicated.

The nature of the underlying cause for the development of the soft-tissue ossifications is not clear nor is it fully understood. The question of trauma to the soft tissue has been noted by previous writers, and there is some evidence to support this contention. As mentioned above, calcification in the soft tissue around the elbow

developed in twenty days after known trauma in one of Brailsford's cases. Delano (11) has recently discussed the relationship of the trophic control of nerves to bone and joints as against trauma as a cause of the arthropathies. He feels that the majority of evidence favors trauma and reports one case of extensive ossification about the right hip in a case of paraplegia. The paraplegia had been present for fifteen years and the patient was always turned on the right side, and never, or very rarely, on the left. This subjected the right hip to trauma and pressure.

Since these patients are completely dependent from the moment of injury, it is conceivable that trauma to the soft tissues may occur. They do not have normal sensation and must be moved frequently. Early in the disease they may have been handled roughly or treated clumsily. With this type of handling, the soft tissues may have become traumatized. Whether unrecognized hematomas have formed at the sites of injury in the soft parts and have acted as a basis for the deposit of calcium cannot be said, but this is a possibility.

On the other hand, the neurogenic influence in the development of the soft-tissue ossifications cannot be disregarded because of their high incidence in neurologic disorders. Even though the factor of trauma may be an important one, it may not be the only one. The development of traumatic myositis ossificans in the injured limbs of the thousands of war casualties in the absence of neurologic disorders was certainly infrequent, while soft-tissue ossifications without definite known trauma are quite frequent in the group of cases which we are discussing. As has been pointed out by Delano, the existence of true trophic nerves has not been proved, yet these patients do have evidence of disturbance of the autonomic nerve supply below the level of the lesion. It may be that trauma to the connective tissues acts as an accessory or trigger factor in the development of the ossifications when there is a disturbance in the nerve supply.



Fig 12 Bony fragmentation at the site of a left subcapital fracture, suggesting an arthropathic joint, erosive changes of both trochanters, and soft-tissue ossifications adjacent to the tops of the trochanters

This patient was struck in the back by a shell fragment on June 11, 1944. This produced a complete paralysis with the level at D-5. Within one and a half months bilateral trochanteric sores had developed. A sacral sore appeared a short time later and became healed only about 16 months after injury. The trochanteric sores were still unhealed in January 1946, but had shown gradual improvement and at that time were only minimal in size. Because of severe flexor spasm, the patient had been up in a wheel chair for only short periods of time and had never been ambulatory in braces. In December 1945 a subcapital fracture of the neck of the left femur was discovered during a survey for bladder stones.

With severe trauma there is a marked catabolic phase, as evidenced by prolonged negative nitrogen and calcium balances beginning shortly after the onset of injury (12). Although the values of serum calcium are not increased significantly, there is increased calcium excretion in the urine. The deposition of calcium in mesenchymatous tissues tends to occur when the normal metabolism is lowered (13). Does the loss of the normal nervous control to traumatized or normal connective tissue lower the normal metabolic level so that the mobilized calcium may be deposited?

As noted above, the earliest lesion observed is the deposit of amorphous calcium in the connective-tissue interstices of the muscles, ligaments, tendons, and joint capsules, or overlying the periosteum or

at the sites of the muscle attachments to the skeletal bones. As a rule, the ossification takes place directly in the calcified area of the connective tissue without the preformation of cartilage, although there is one case reported with precartilage formation (1).

Soule (14) believes that the early amorphous calcium deposit as observed in the roentgenograms of these cases is actually amorphous bone similar to callus. However, without histologic proof this cannot be positively assumed. Whether it remains as calcium in an amorphous state or develops into bone depends upon the presence of an adequate blood supply to the calcium mass.

In some cases there are rather extensive ossifications in the soft tissues adjacent to



Fig 11 Low power photomicrograph of biopsy specimen showing the characteristic pathological changes. Note the granulation tissue overlying trabeculae in various stages of resorption. The cortex is completely gone. The fatty marrow has been replaced by fibrovascular tissue.

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develop in just this situation. In order to have mobilization of calcium, one must have an intact blood supply. In the earlier stage of this condition, Dr. Heilbrun has shown that we have a hyperemia. This would account for the early mobilization of the calcium. Later, there is a decreased blood supply, which brings about a fibro osseous reaction and is

responsible for the eventual bone production. Trauma, of course, plays an important role, as well as the lowering of the local metabolism.

As stated by Dr. Heilbrun, the neurogenic factor may be the primary one, followed by the others later. Further study is obviously required for an understanding of this particular situation.



areas of severe erosion. The inflammatory hyperemia must involve this whole general area, instead of being sharply limited to the area directly over the erosion. In the presence of hyperemia, decalcification usually occurs, and with a diminished blood supply calcium is laid down. What are the underlying factors which allow these ossifications to develop so close to an area of hyperemia? It is difficult to offer an adequate explanation for this paradox. Since there is evidence that the ossifications are present relatively early after the spinal cord injury, it may be that they are formed before the hyperemia of the area reaches its full development. After their formation the general hyperemia may not be extensive enough for their resorption.

SUMMARY

1 The erosive bone lesions and the soft-tissue ossifications which were observed in a survey of 99 cases of paraplegia have been described. Although they frequently occur in the same individuals, it is to be emphasized that etiologically they are unrelated.

2 The erosive lesions develop where soft tissue over bony prominences, as the trochanters, becomes devitalized. Pathologically this is evidenced by a subacute and chronic infection of the tissue overlying the bone, with extension to the superficial layers of bone. This leads to resorption of the cortex and underlying trabeculae. The bone marrow is replaced by fibrovascular tissue which accompanies the low-grade inflammatory process.

3 The factors relating to the formation of the soft-tissue ossifications have been considered. Although soft-tissue trauma may play an important role, the neurogenic influence cannot be disregarded.

NOTE The authors are indebted to Dr A B Soule, Jr, for his many valuable suggestions to Dr H L Jaffe for his kindness in examining the pathological material, to Dr S L Meltzer for the use of some of his material, and to Capt E Ernst, Jr, for conducting part of the survey.

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DISCUSSION

Paul C Swenson, M D (Philadelphia, Penna.) Dr Heilbrun deserves a great deal of commendation for having made such an interesting and complete study of this unusual sequela in paraplegics. Apparently, more cases of this sort have been seen than during the First World War and they merit a rather complete analysis and study. The present description has been very complete and requires little comment or addition.

I would like, however, to discuss very briefly some of the points in the etiology. Just what should allow for this mobilization of calcium from the eroded bone and its redeposition in the soft tissues overlying it is a most intriguing question. For a number of years I have been interested in the bone thickening underlying the soft tissues where varicosities are found. Usually a diffuse condensation of the cortex develops, particularly when infection has supervened in the soft tissues containing the varices. In the poorly nourished tissues ulcers quickly develop with subsequent infection and I have seen a condition almost identical with what has been shown today.

lium (1) and the production therefrom of thin vacuum-tight sheets led to the first commercially produced tubes with vacuum-tight beryllium windows in the external envelope, as reported by Machlett (2) in 1942. These tubes were designed primarily for x-ray diffraction work, having targets of special materials, such as molybdenum, cobalt, copper, iron, or chromium. The beryllium window was sought for such tubes in order to reduce to a minimum the loss of intensity due to absorption in the window of the characteristic radiation of the target material, which is of relatively

difficulties involved in the fabrication of vacuum-tight beryllium windows increase many-fold, particularly in the operation of brazing the windows in a permanently vacuum-tight manner to a suitable base for incorporation into the tube envelope. Nevertheless, the necessary technics have been perfected, and tubes with beryllium windows admitting a 40-degree solid angle cone of rays (Fig 1) have now been available for some time (6).

As indicated above, such tubes were first developed to meet the needs of certain special radiographic applications, arising

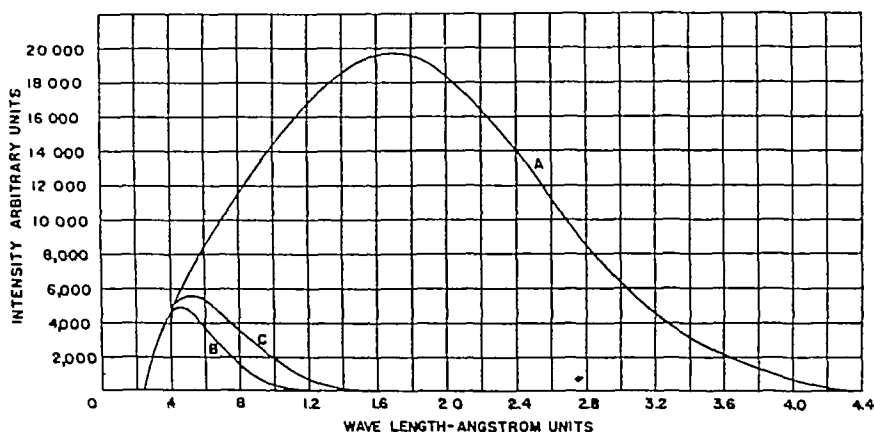


Fig 2 Calculated intensity wave length distribution of x-radiation at 50 kv, (A) filtered by 1 mm Beryllium, (B) filtered by 1 mm Aluminum, (C) filtered by 1 mm Pyrex glass. Intensity expressed in terms of ionizing power

long wave length, particularly in the case of the lower atomic number materials like cobalt, iron, and chromium. In these and other tubes (3) designed primarily for diffraction studies, the window may be quite small, since only a narrow pencil of rays is employed.

The advantages of this low-absorption window for other applications were soon recognized, and these so-called "diffraction tubes" were used advantageously in such special radiographic procedures as micro-radiography (4, 5) and the checking of spot-welds of thin aluminum sheets. In some of these applications, a wider beam had to be employed to cover larger areas than was possible with the diffraction tubes, and a larger window was therefore required. As the size is increased, the

principally in connection with the war effort. It is natural to inquire whether they offer possibilities for advantageous use in the medical field, as well as in other industrial applications. To arrive at an answer to this inquiry, it is desirable to investigate the nature of the radiation obtainable from the tubes, both qualitatively and quantitatively.

The "quality" aspect of this radiation can probably be explored most readily by means of calculations based on Kramers' formula (7) for the energy of x-ray emission at all wave lengths throughout the continuous spectrum. The intensity-wave-length distributions for x-rays generated at 50 kv and modified by absorption by a 1 mm thickness of beryllium, aluminum, and Pyrex glass, respectively, have

High-Intensity Radiation from

Beryllium-Window X-Ray Tubes¹

T H ROGERS
Springdale, Conn

THE LOW ATOMIC number and low density of beryllium give it the lowest absorption coefficient of any material which might, by virtue of other suitable physical characteristics, be employed for windows in x-ray tubes. The first use of

but in an internal hood surrounding the target, the purpose of which was to prevent the bombardment of the tube walls by secondary electrons. Beryllium windows permit such hoods to shield completely against electrons while absorbing the x ray

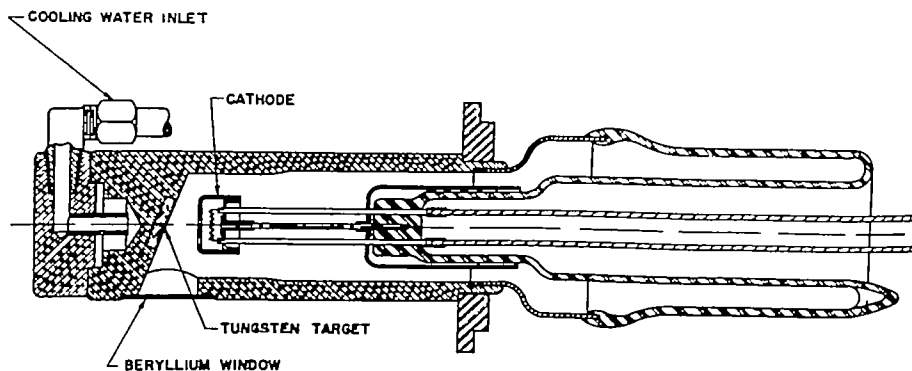
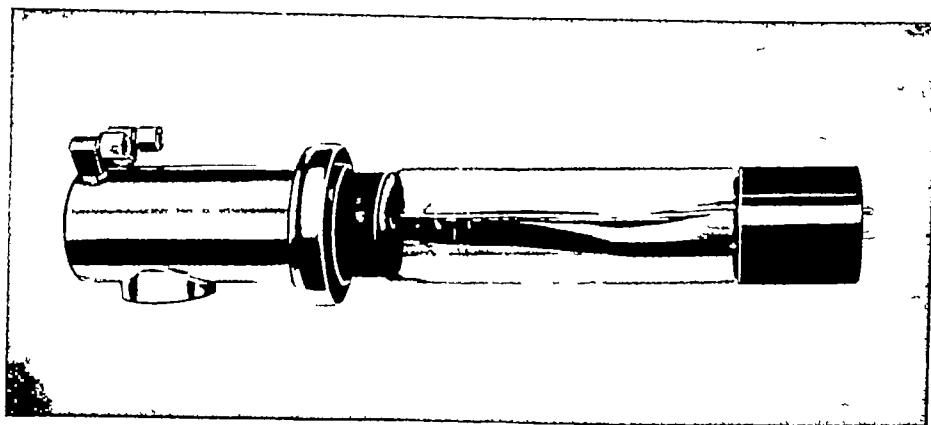


Fig 1 Beryllium window tube providing 40-degree x ray beam (Courtesy Machlett Laboratories Inc)

beryllium plates for such a purpose appears to have been in Germany, and shortly thereafter in this country, in the early 1930's, when they were used, not as windows in the external envelope of the tube,

beam to a negligible extent. There is, of course, no requirement that such windows be vacuum-tight, as is the case in the external envelope.

The development of malleable beryl-

¹ From the Engineering Department Machlett Laboratories Inc Springdale Conn Presented at the Thirty second Annual Meeting of the Radiological Society of North America Chicago Ill Dec 1-6 1946

in the three cases may be obtained by integrating the areas under the three curves, giving proportions as follows Beryllium, 100, Pyrex, 7.9, Aluminum, 4.9

The relationship between voltage and wave-length distribution is indicated by a similar calculation for 60, 50, and 30 kv, respectively, with results as plotted in Figure 3. These curves show the relative outputs for a beryllium window 1 mm thick and a Pyrex glass window 1 mm thick at the three voltages. Integration of the areas under the respective curves indicates the following relative total intensities

	60 kv	50 kv	30 kv
Beryllium	100%	78%	40%
Pyrex	9.8%	6.2%	1.9%
Ratio $\frac{\text{Pyrex}}{\text{Beryllium}}$	9.8%	7.9%	4.8%

The physical measurement of the actual intensity in roentgens per minute of radiation containing wave-length components in the range admitted by the beryllium window presents certain difficulties not encountered in ordinary dosage measurements. The type of low-voltage chamber devised by Taylor and Stoneburner (8), used in the manner described by them for measurement of "Grenz rays," constitutes a suitable standard of accuracy in such dosimetry. Smaller chambers of the closed type, desirable for the sake of convenience in routine measurements, introduce considerable error unless adequate precautions are taken in their design and construction to avoid appreciable absorption in the wall.

Trout and Atlee (9, 10) made measure-

ments of the output of experimental beryllium-window tubes using the Victoreen thimble chamber. Their reports include only absorption curves showing percentages rather than absolute values. It is apparent that dosage values determined in this way will be in considerable error due to absorption in the chamber wall. The extent of the error is indicated by the subsequent work of Victoreen, Atlee, and Trout (11), which showed that at a wave length of 1.5 Ångströms, the Victoreen chamber gives a reading of only 50 per cent of the actual dosage. They describe an experimental chamber of beryllium, showing an error of 10 per cent at 1.5 Ångströms. Inasmuch as a major proportion of the radiation is at wave lengths greater than 1.5 Ångströms (see Fig. 2), even greater errors can be expected when measuring such radiation with chambers of these types.

The "mesh" chamber described by Quimby and Focht (12) for dosage measurements for "contact therapy" apparatus should give results of suitable accuracy with this radiation. Braestrup (13) has constructed a somewhat similar chamber employing extremely thin films of nylon coated with graphite, which is reported to give results comparable with the standard.

Measurements made by Braestrup (13) of the output of the large-beryllium-window tube described above, by means of the Taylor and Stoneburner chamber, provide a quantitative as well as qualitative indication of the intensity obtainable. The measurements are tabulated below, and the corresponding absorption curves are plotted in Figure 4.

kv (c p)	T D	Added Filter	r/min /ma	Percentage Trans	h v l in mm Al
50	10 cm	0	1,555	100	0.07
		0.05 mm Al	903	58	0.09
		0.1 " "	605	39	0.11
		0.5 " "	104	8.7	0.55
		1.0 " "	53	3.4	0.94
		2.0 " "	25.7	1.65	1.50
		3.0 " "	16.1	1.03	1.71
		5.0 " "	7.2	0.46	
		0.5 " Be		71.0	
		1.0 " "		52.0	
		2.0 " "		32.5	
		0			
			46,600		
50	2 cm	0			

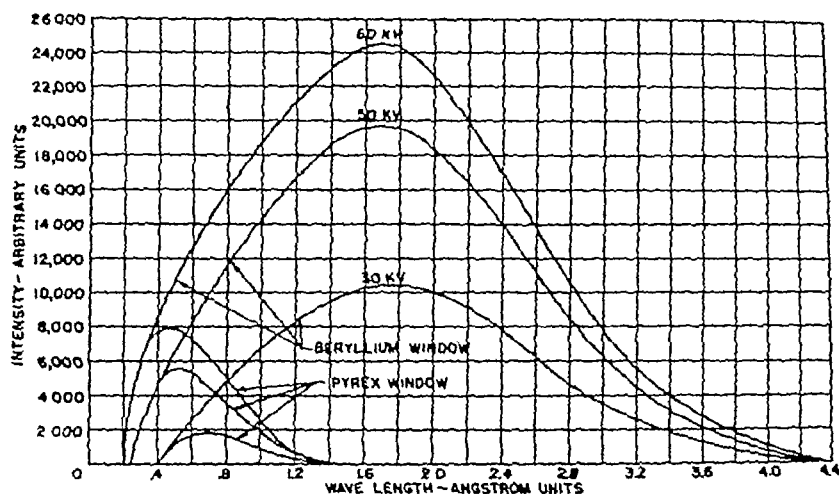


Fig 3 Calculated intensity-wave length distribution of x radiation at 60, 50, and 30 kv Window thickness 1 mm

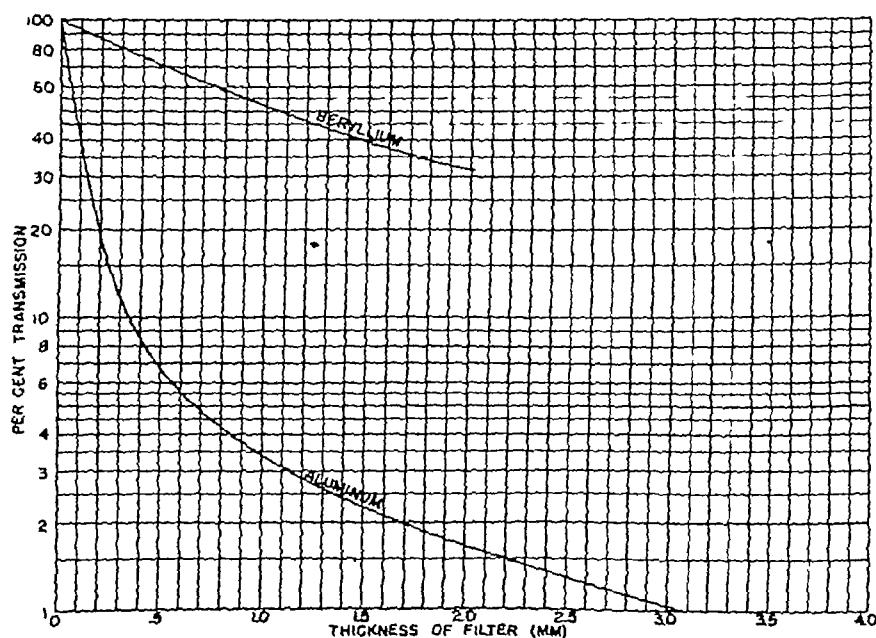


Fig 4 Absorption curves for output of beryllium-window tube at 50 kv with aluminum and beryllium filters respectively

been thus calculated (6), with results as plotted in Figure 2. The intensities are in terms of energy absorbed in air, expressed in arbitrary units, and are thus approximately proportional to roentgens per minute. These plots indicate, to some degree of approximation at least, the relative importance of each wave-length component

of the radiation making up the total intensity. It will be noted that a major proportion of the radiation obtainable from the beryllium-window tube consists of wave-length components which are entirely eliminated by a window of Pyrex or aluminum of equal thickness. An approximation of the relative total intensities

to any required degree, at least to the same extent as is accomplished with contact therapy, which depends on a very short target distance so that diminution in depth dose is partly dependent on the inverse-square law. Adequate studies of dosage rates and depth dose factors as a function of voltage, distance, and filtration will of course have to be made before such techniques can be established.

For therapy of most skin disorders, the work of Andrews and Braestrup (17) indicates a definite advantage in employing

a therapeutic medium. Beryllium-window tubes are ideally suited to the generation of such rays, without involving the fragility of previous Grenz ray tubes with their windows of Lindeman glass or very thin bubble-like glass. Inasmuch as operation may be at any desired voltage from 3 to 50 kv, possibilities of large scope exist for extending or improving on past techniques in this field. Thus, in the therapeutic field, a single unit having sufficiently wide versatility to enable it to handle skin therapy, intracavity therapy, and Grenz ray therapy

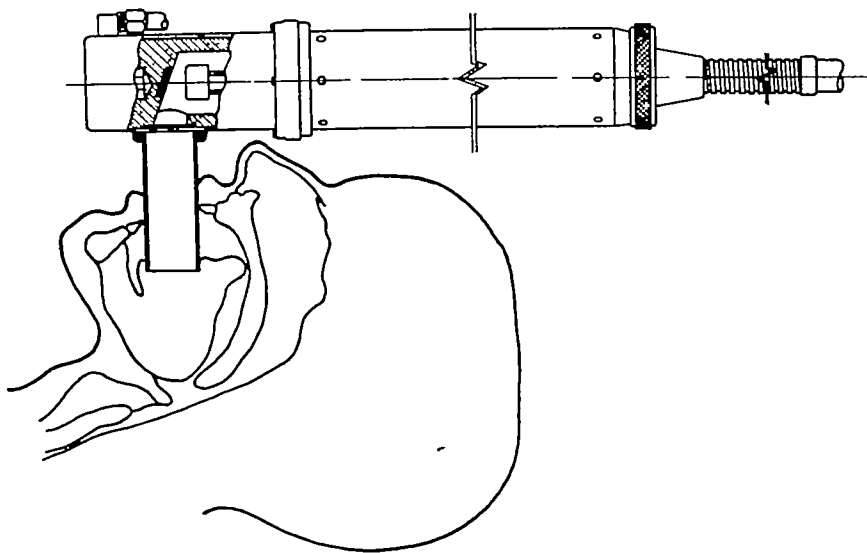


Fig 6 Suggested arrangement for intracavity therapy

kilovoltages considerably lower than earlier common practice, together with considerable filtration, so as to obtain quite homogeneous radiation of optimum penetration. Such technique requires a high milliamperage to obtain a reasonable dosage rate. The possibility is indicated that even lower voltages with higher milliamperage, such as are permissible with the presently available beryllium-window tubes, may result in optimum conditions for most such treatments. Thus another fruitful field for exploration is extended by these tubes.

The range of radiation designated as "Grenz" rays (18), usually considered to consist of radiation generated at from 3 to 12 kv, has found a degree of acceptance as

may be developed employing a tube of this type.

The potentialities of radiation of the nature obtainable from such tubes in the field of biological research, of direct and indirect interest to the medical profession, merit investigation by biophysicists and biochemists. The large dosage rates, easily controllable over a very wide range, present opportunities in that field too numerous to mention.

Outside of the medical and biological fields, opportunities for research and experiments in industrial fields are endless. X-ray photochemistry, wherein the nature of materials is altered by exposure to x-rays can be explored on a much wider basis than

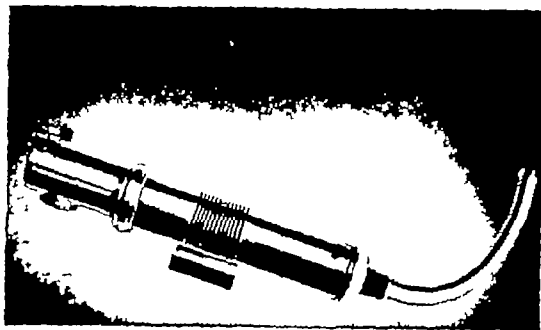


Fig 5 Shock-proof tube with beryllium window, 40-degree x ray beam (Courtesy Machlett Laboratories, Inc.)

The value given for 2 cm target distance is calculated from the measurement at 10 cm by applying the inverse-square law and correcting for absorption in the intervening air on the basis of absorption per cm at a 10 cm distance. There is a certain amount of indeterminable error in both of these corrections, due to the focal spot being of finite size and due to the continuous change in quality with added air filtration, but the two elements of error are in opposite directions and tend to cancel each other.

Tubes of the type described are capable of operation at any voltage up to 50 kv, and with currents up to 50 ma. The properties of beryllium, in addition to affording minimum loss of radiation by absorption, permit locating the window very close to the focal spot, which would not be feasible with any other low-absorption material such as Lindeman glass, bubble type glass, or aluminum foil, because of the heating involved if high energies are to be used. Hence, a target distance of 2 cm to the outer surface of the window becomes possible. On the basis of the output data of the above table, an intensity of 2,330,000 roentgens per minute is obtainable at this distance, with 50 ma at 50 kv.

This high roentgen intensity, being so far in excess of values commonly encountered, suggests many intriguing possibilities. Numerous experiments have been performed on sterilization by x-rays. Those of Clark (14) and of Wyckoff (15)

agree with many others in showing a logarithmic death rate for bacteria subjected to large dosages. The dosages for complete sterilization have seemed, in the past, to be such as to preclude such processes on a commercial basis. The availability of dosage rates in the order of 2,000,000 r per minute can greatly facilitate such experiments and would render commercial utilization definitely feasible, at least for certain materials of high value. Examples of such applications are provided by recent experiments by Clark (16), which indicate definite success in the preparation of vaccines by the irradiation of bacterial suspensions, the bacteria being killed while the antibodies remain unaffected in the very short time required for the lethal dose with this type of tube. Other possibilities are the sterilization of suture material that cannot be subjected to sufficient heat to accomplish sterilization, and the sterilization of a wide variety of food products without subjecting them to flavor-destroying temperature.

Of more direct interest in the radiological field are the therapeutic possibilities of this new tool. While a dosage rate of 2,000,000 r per minute can hardly be used directly for treatment purposes, nevertheless an infinite number of possible combinations of voltage, milliamperage, distance, and filtration make available a wide range of dosage rates and depth dose factors, making such equipment adaptable for applications ranging from intracavity therapy to so-called "Grenz" ray therapy, including also the normal skin therapy applications.

For intracavity irradiation, which is usually done with so-called "contact" therapy apparatus, the compact shock-proof form of the tube, as illustrated in Figure 5, lends itself to the procedure of introducing into the cavity a field-defining tunnel or cone through which radiation from a distance of 10 cm, more or less, can be directed to the area to be treated, as indicated in Figure 6. The size of the cone employed need be no larger than the lesion to be treated. By proper selection of voltage, depth dose could be minimized.

To attempt to look a bit into the future, it can be anticipated that processes may be developed to utilize the extremely high intensity of ionizing power which beryllium-window tubes make possible, for sterilization or for the production of various photochemical reactions. In such cases, it will be desired to process the largest possible volume of material in the shortest possible time. Still higher currents and

narrow beam taken out from the diffraction tube, in the form of a 12-degree solid angle cone, includes only about 0.5 per cent of the total. The 40-degree beam of the newer tubes takes in about twelve times more, but that is still only about 6 per cent of the total.

A tube of new design previously described by the author (6) and constructed on an experimental basis makes all of the

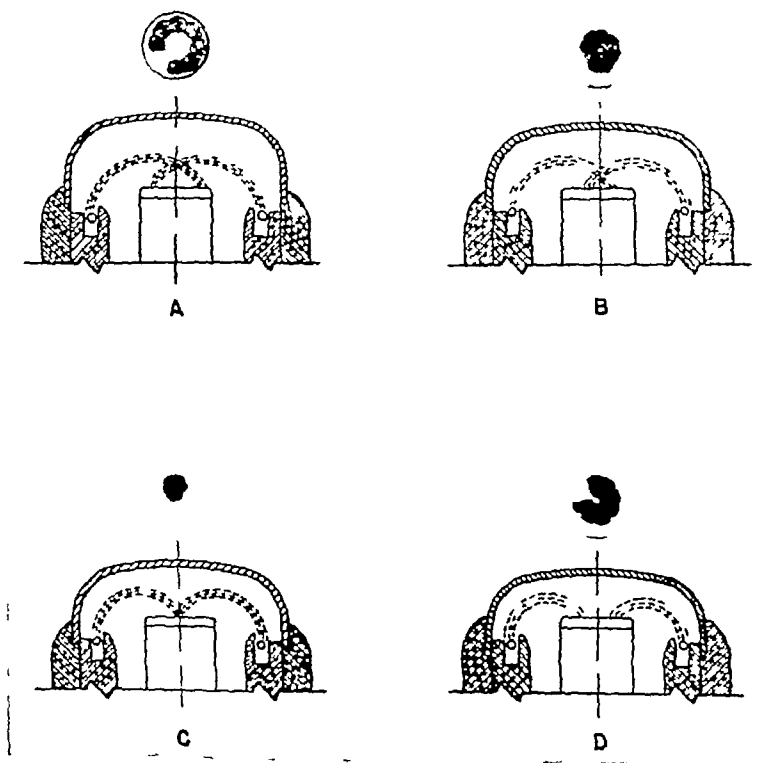


Fig 8 Diagrams of focusing obtained with domed window tube at various positions of the window with reference to the anode. (Actual pin hole focal diagrams compared with schematic diagrams of electron trajectories.) A Maximum spacing produces "ring" focus. B Somewhat closer spacing produces circular focus of large size. C Spacing adjusted to produce minimum size focus. D Still closer spacing again results in "ring" focus.

voltages will be advantageously employed for still greater intensities. It will also be desired to utilize all of the radiation generated at the focal spot, not merely the relatively narrow beam required for most diagnostic and therapy applications. The radiation given off from the focal spot radiates in all directions with essentially equal intensity throughout the 180-degree solid angle subtended by the target face. The

radiation available for use in the continuous processing of materials. The principles of this design are shown in Figure 7. The window takes the form of a dome into which the anode protrudes. The filament is in annular form surrounding the anode and located in a plane behind the plane of the target face so that it does not cast a shadow in the hemisphere of radiation. The dome is at cathode potential, and the

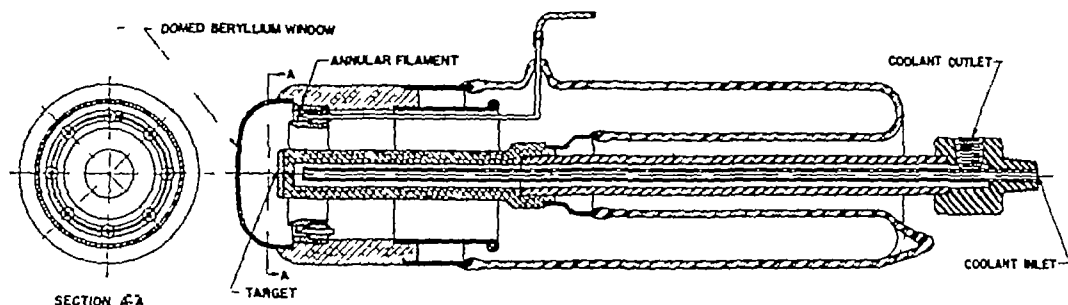


Fig 7 Schematic view in section of beryllium-window tube providing 180-degree solid angle x-ray beam

heretofore, now that a 2,000,000 r per minute source of rays is available. One example that naturally suggests itself is the possibility of assisting the research which is a necessary part of the atomic energy development program. Materials to be employed in atomic power plant engineering must be investigated as to their ability to withstand intense radiations of various sorts. Of the types of radiation involved, gamma rays are the most penetrating and probably present the greatest problem. Inasmuch as the effects of x-rays and gamma rays on material are similar, producing ionization which results in observable changes, the effect of very intense radiation on small samples of any desired material can be studied with extreme simplicity with such apparatus. A very interesting type of photochemical reaction, reported by Pough and Rogers (19), is the change in the color of certain gem stones when subjected to the radiation from these tubes for relatively short periods. Pale yellow sapphires have been turned to a brilliant orange by a five-minute exposure. Clear lavender specimens of spodumene have changed to a brilliant green, identical in appearance with the rare hiddenite variety. Another photochemical effect, of immediate interest to the medical profession, is the decomposition of sulfa drugs by x-rays. This reaction has been obtained and is being quantitatively studied by Clark (16), following clinical observations that patients who were given both sulfa drugs and x-ray therapy experienced no desirable effects from the former.

Clark (16) has also found that, with the

intense radiation obtainable with beryllium-window tubes, unknown materials can readily be analyzed as to chemical composition, both qualitatively and quantitatively, by spectroscopically analyzing the secondary characteristic fluorescent x-rays generated in a sample. With this primary source, the secondary rays are strong enough to be analyzed by a simple crystal spectrometer without any unusual arrangements.

To summarize, beryllium-window tubes now available provide a beam as wide as the usual diagnostic tube, namely, 40-degree solid angle cone, with the outer surface of the window approximately 2 cm from the focal spot. Operating at maximum capacity of 50 ma at 50 kv, such tubes make available a dosage rate in the order of 2,000,000 roentgens per minute at the window. The scope of possible applications for such tubes is at present relatively unexplored, but many promising possibilities suggest themselves in the fields of sterilization, intracavity therapy, skin therapy, biological research, and photochemical research. Further explorations in these fields will necessitate many measurements of this "soft" x-radiation, for which some of the conventional dosage measuring devices and methods are not suitable. A caution should be registered to the effect that, in the calibration of such apparatus, the usual bakelite thimble chambers should not be employed. Calibration must be carried out by one familiar with the properties of this kind of radiation and the special problems associated with its dosimetry.

Per unit of weight it absorbs about ten times less of the soft x-rays than air, and it thus permits radiation of long wave length to pass out from the tube

Beryllium, being a metal, can furthermore tolerate a great amount of heat and the window can, therefore, be placed close to the anode where the intensity of radiation is extremely high under the conditions mentioned by the essayist. The short anode-window distance, as well as the low penetrability of the rays makes it difficult to obtain accurate measurements. It seems important, therefore, that special measuring instruments should be designed and recommended for use when the new tubes are being sold.

The new tubes offer several evident advantages over any previously available. For one thing, they can be used over a wide x-ray range, from a very low half-value layer to a relatively high one. One tube can be used for both Grenz-ray therapy and contact therapy, and can thus replace two types of tube.

Other purposes for which these new tubes can be used have already been mentioned, but it may be well to emphasize the advantages they offer for irradiation of bacteria and chemical compounds.

The tremendous intensity will, in a relatively short time, produce reactions which have been very difficult to obtain in satisfactory quantities. It will become much easier to study the changes produced, and it seems probable that some of the products will become of practical importance. It must, however, be remembered that the intensity changes very rapidly, so that the upper layer of the irradiated material will receive much more exposure than the lower portion if it is of any appreciable thickness.

It is an unsettled question whether nearly monochromatic radiation would be of value for therapy. These new tubes offer an opportunity to determine that experimentally. The intensity is high enough so that treatments could be given with a narrow wave-length range if suitable target and filter material were selected. It may, for instance, be of importance to use the characteristic radiation of iron, even though the penetration of this radiation is so slight that it could not be applied to any appreciable depth in the tissues.

The dome type tube, which evidently is not yet completely developed, will undoubtedly have great usefulness for therapy in the future.



resultant electric field in the space between dome and anode is such that the electrons from the filament describe trajectories which terminate on the target approximately as indicated in the diagram in Figure 8

The formation of such a dome of the malleable beryllium referred to above has been proved to be technically feasible, though not yet reduced to commercial practice. The completion of a commercial design awaits indication of a form properly

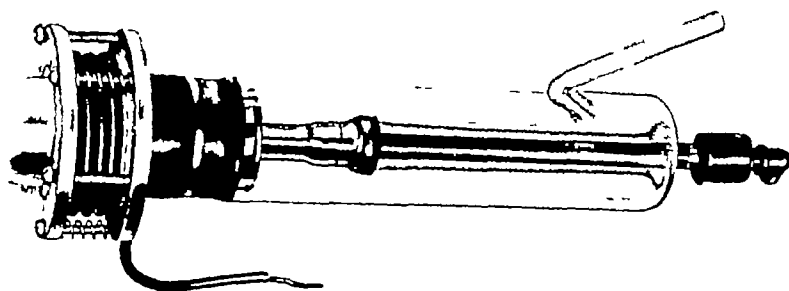


Fig 9 Experimental tube with domed window permitting 180-degree solid angle x ray beam (Courtesy Machlett Laboratories Inc)

suitable for desirable processes which are yet to be developed. An experimental model has been constructed operable with a load of 100 ma at 60 kv (Fig 9). Extrapolation of the intensity measurements tabulated above indicates an intensity of approximately 5,000,000 roentgens per minute, which would be available over an area of approximately 25 sq cm. The uses that can be made of radiation like that are not likely to go long unexplored.

Machlett Laboratories
Springdale, Conn

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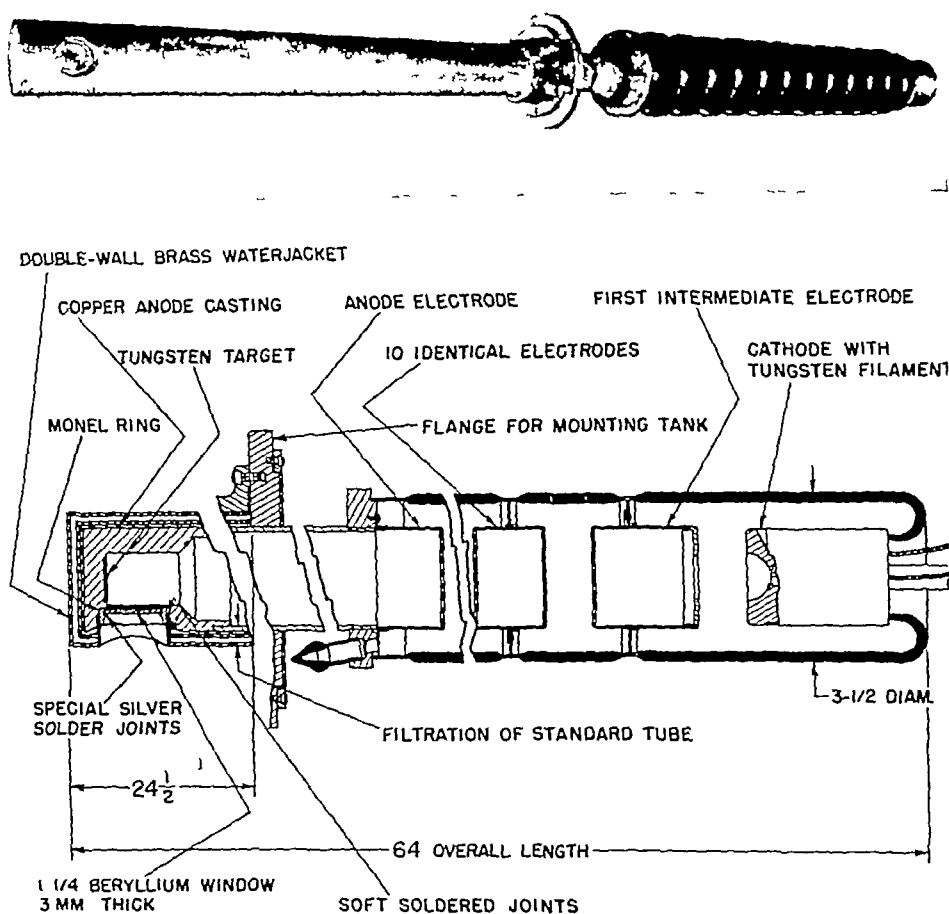
DISCUSSION

K. W Stenstrom, Ph D (Minneapolis, Minn)
Many years ago we searched for suitable window material for x ray tubes when very soft (long wave length) radiation was studied, and we had a great deal of trouble finding anything useful. We looked at the periodic table of the elements and wished that beryllium were available. Now it is finally produced in thin sheets and it is the ideal material

cause of the beryllium window At 1,000 kv, the slope of the curve is quite flat, differing little from the curve taken with the conventional type of tube, indicating little advantage for the beryllium This is probably due to the fact that the mass absorption coefficients of all elements

lead is presented in Figure 4 It will be noted that at 1,000 kv for zero added filtration the half-value layer is 1.1 mm of lead In the conventional million-volt tube it is 1.9 mm of lead

Figure 5 shows the half-value layers obtained throughout the 500-kv range of the



Figs 1 and 2 Beryllium-window million-volt tube and cross-sectional view showing beryllium-window construction

approach each other at wave lengths of this order It serves to emphasize the point that in such a tube the thickness of the window is more important than the material from which it is made This suggests the building of a tube with a thinner window, perhaps by similar water jacket construction with the anode copper extension wall milled very thin

A similar set of transmission curves for

measurements At 500 kv the half-value layer of 0.04 mm of lead certainly indicates soft radiation

A comparison of transmission values for lead and copper throughout the 500-kv range is shown in Figure 6 Here again approach to equality of mass absorption coefficients at the shorter wave lengths is illustrated

Some idea of the r/min output actually

Low-Absorption Roentgen-Ray Measurements from 500 to 1,000 Kilovolts¹

E D TROUT and Z J ATLEE

Chicago, Ill

EARLIER papers (1, 2) by the authors have reported on low-absorption roentgen-ray measurements from 10 to 400 kv. In these cases, the extremely low absorption was made possible by special beryllium-window permanently evacuated tubes. This paper reports an extension of this work to voltages of 500 to 1,000 kv. Roentgen-ray tubes for voltages above 400 kv usually have not had a glass window for the useful beam of γ -rays, rather their exit has been through the wall of a metal anode extension chamber of some sort. This has resulted in high inherent filtration for such tubes and made it especially desirable to obtain physical data at voltages up to 1,000 kv from a tube having essentially zero filtration.

BERYLLIUM-WINDOW MILLION-VOLT TUBE

About a year ago it became possible to obtain the desired data, as a result of the experimental construction of a sealed-off multisection million-volt tube with a beryllium window for the reflected beam. The tube used is shown in Figure 1 and aside from the beryllium window is the standard million-volt tube as used extensively with the 180-cycle resonant transformer in a freon-filled tank. The details of this unit have been described elsewhere (3), and more recently a two-million-volt unit of the same fundamental design has been produced (4).

Details of the design of the beryllium-window assembly and water jacket, together with some detail of the tube itself, are shown in Figure 2. The water jacket for cooling the anode wall and target is soldered to the window in such a fashion that the only absorption for this part of the reflected beam is the beryllium window.

In the standard tube the inherent filtration would be the copper wall of the anode, the water, and the two brass jackets, for a total of approximately 6 mm copper equivalent. (This is indicated in Figure 2 as filtration of the standard tube.) The inherent filtration of the beryllium-window tube is only 3 mm of beryllium, which will be shown later to be equivalent to about 0.05 mm of lead. The beryllium window used was 1 1/4 in. in diameter and with some loss for the soldering fillet gave a coverage of a 50 cm diameter circle at one meter, which was more than ample for all the measurement work as well as radiographic results reported on elsewhere (5).

As mentioned previously, this tube became available nearly a year ago, and the measurements to be reported were made at that time. Since then the tube has been used for other work, and its performance has left nothing to be desired.

ROENTGEN-RAY MEASUREMENTS

All the measurements were made with a Victoreen condenser type thimble chamber at 100 cm distance and tube currents varying from 0.1 to 3.0 ma. The kilovoltage was varied at will throughout the 500 to 1,000 kv range without incident. Because of filament limitation by space charge, a maximum of 1.0 ma at 500 kv was used. Absorption data were taken in both copper and lead, since these are the materials normally used as filters at these voltages.

In Figure 3, curves are plotted for transmission data for copper. It will be noted that for voltages up to 750 kv, a few tenths of a millimeter of added copper drops the output rapidly. This, of course, is the measure of the soft radiation present be-

¹ Presented at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-6, 1948.

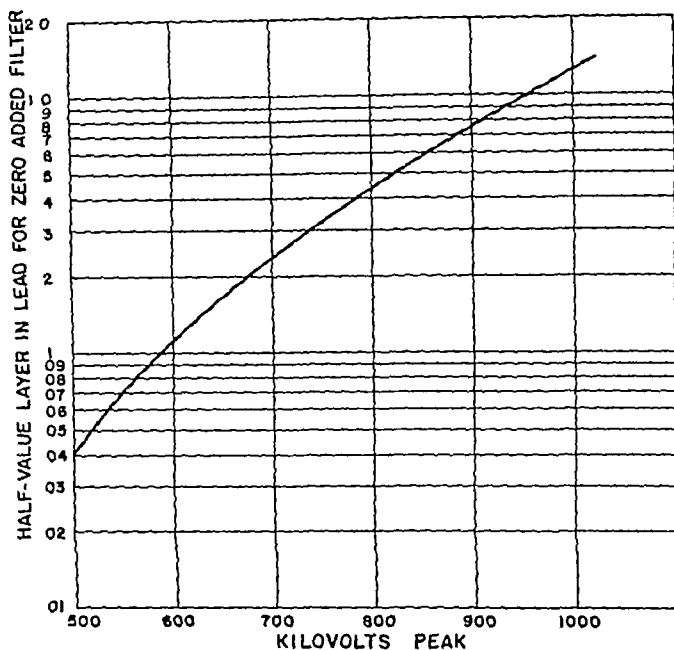


Fig 5 Half-value layers in lead with low initial absorption for voltages of 500 to 1,000 kv

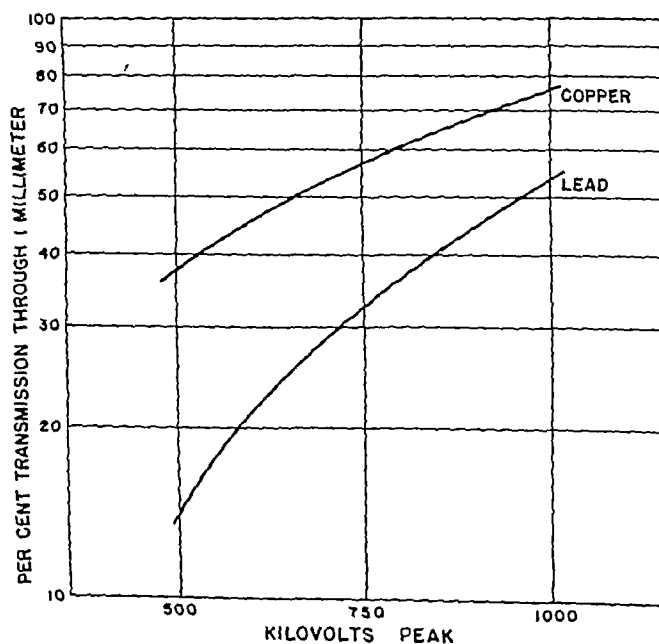


Fig 6 Per cent transmission through 1 mm copper and 1 mm lead for voltages of 500 to 1,000 kv

might be of interest for biological experimentation

By calculation from Figure 3, Figure 8 provides the necessary graph for determining the inherent filtration in lead of any

x-ray tube operating in the range of 500 to 1,000 kv with a measurement of only the half-value layer in lead. The significance of this method of determining the inherent filtration has been amply covered in the

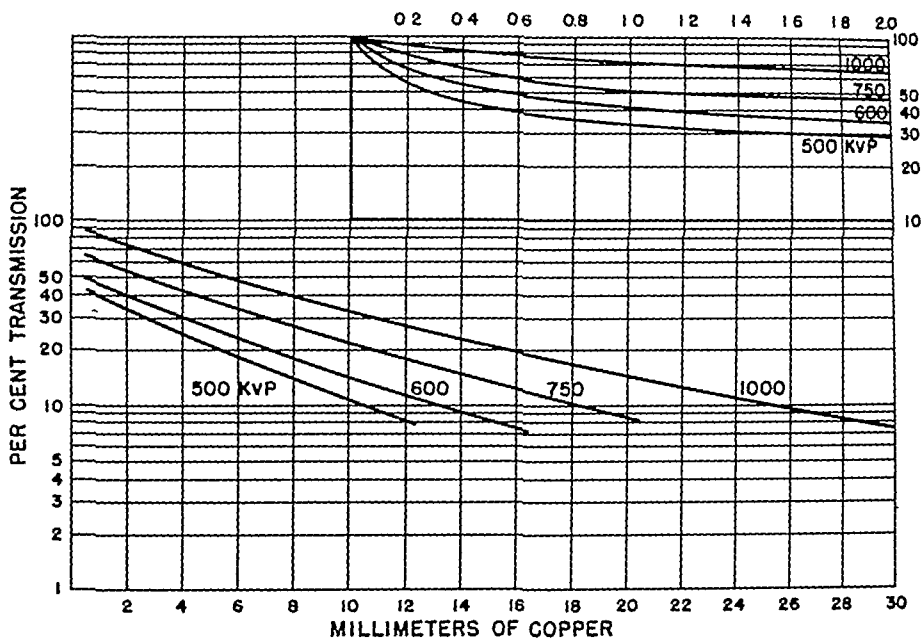


Fig 3 High voltage low initial absorption roentgen ray transmission for copper

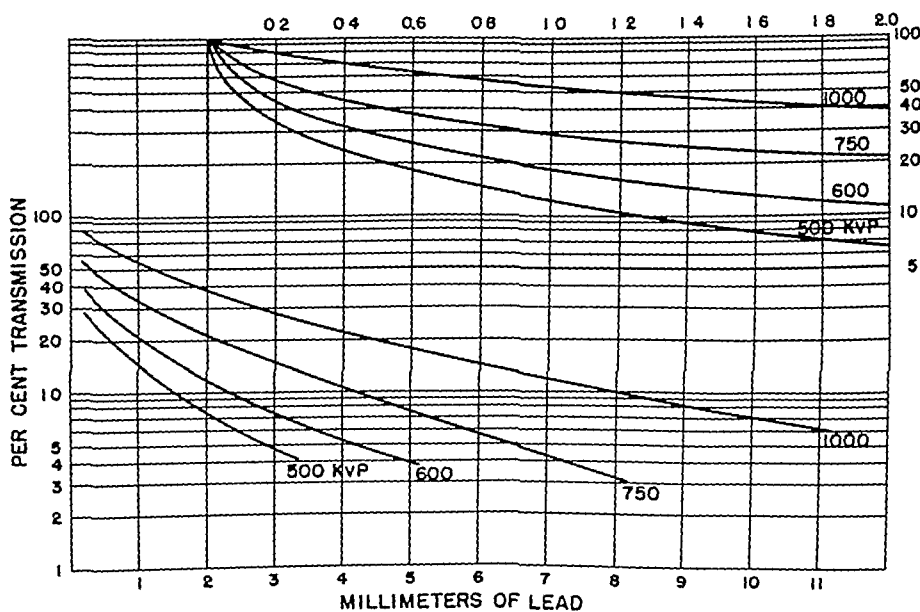


Fig 4 High voltage low initial absorption roentgen ray transmission for lead

obtained from this tube can be had from Figure 7. At 1,000 kv and 3 ma, which is full-load rating, and at the usual treatment distance of 50 cm, the output would be 264 r/min. To give some idea as to the intensity of the radiation present at the

closest distance possible for irradiation of small samples, which would be about 2 cm in contact with the beryllium window, by inverse-square-law calculation we would have $2,500 \times 66$ (r/min at 30 ma), or 165,000 r/min. A beam of this intensity

2 Roentgen-ray data obtained from the tube on the reflected beam for a voltage range of 500 to 1,000 kv are presented

3 A graph is given for determining inherent filtration of any roentgen-ray tube operating at as high a voltage as 500 to 1,000 kv when only the half-value layer in lead and operating voltage are known

4 The conclusion is reached that beryllium windows are indicated for tubes operating up to 750 kv, but that at 1,000 kv and higher the emphasis should be placed on a "thin window" rather than its composition

Construction of a two-million-volt tube with thinner beryllium window is under way for measurement in the range of 1,000 to 2,000 kv. It was hoped that results obtained with it could have been included in this paper, but unforeseen difficulties prevented

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General Electric X-Ray Corporation
Chicago 4, Ill

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- 4 CHARLTON, E. E., AND WESTENDORP, W. F. Mobile Industrial X-Ray Unit. *Electronics* 17 128-133 1944
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- 6 TAYLOR, L. S. AND SINGER, G. Standard Absorption Curves for Specifying the Quality of X-Radiation. *Radiology* 22 445-460, April 1934

7 BEHNKEN AND NITKA. *Phys Ztschr* 36 459, 1935

8 THORAEUS, R. Standard Curves of Absorption of Roentgen Rays in Aluminum and Their Employment for Estimating the Equivalent of the Initial Filtration in Roentgen Tubes. *Acta radiol* 21 603-614, 1940

DISCUSSION

Lauriston S. Taylor, Ph.D. (Bethesda, Md.) This paper by Mr. Trout and Mr. Atlee is very nicely done indeed. We have been hoping in our own laboratory to do a job like this for a long time, because we have felt the real need for it, and I am sure that it is going to be particularly useful in this high-voltage x-ray region. Here, for various reasons, it is necessary to have rather massive and complicated target structure areas and the x-rays, after they pass through these variable windows, may be considerably changed both in their quality and their intensity. Such target mountings can be pretty formidable affairs for various constructional reasons, and, because of the softening and reduction of the x-ray output, it is necessary for economic reasons that we avoid adding any unnecessary filtration to the beam after it leaves the tube.

The question has always been, What is the necessary filter to be added? The data that were presented this morning will provide, I believe, the whole answer to that question. This is a matter of economy, and I really don't take it to be a question of hairsplitting at all.

Some time ago these same workers reported a similar piece of research in the very low-voltage region. This has already demonstrated both its economic and technical usefulness in a really big way, and I see no reason to believe that the work in the very high-voltage region is not going to prove equally useful.

We have been up against the problem in connection with our own million and a-half-volt plant. We have had no way of obtaining absorption data for zero or essentially zero filtration between the source of radiation (the target) and the ionization chamber. We have wondered in our own minds just what to do about the question of the filtration that we have had in the water jacket and in the target container. The conclusion of the authors, that for very high voltages the window material is itself immaterial, is very comforting. It is not entirely unexpected, but one always likes to see these things clearly proved before going ahead with a design for an expensive installation. I should like again to congratulate the authors on a good job, well done.

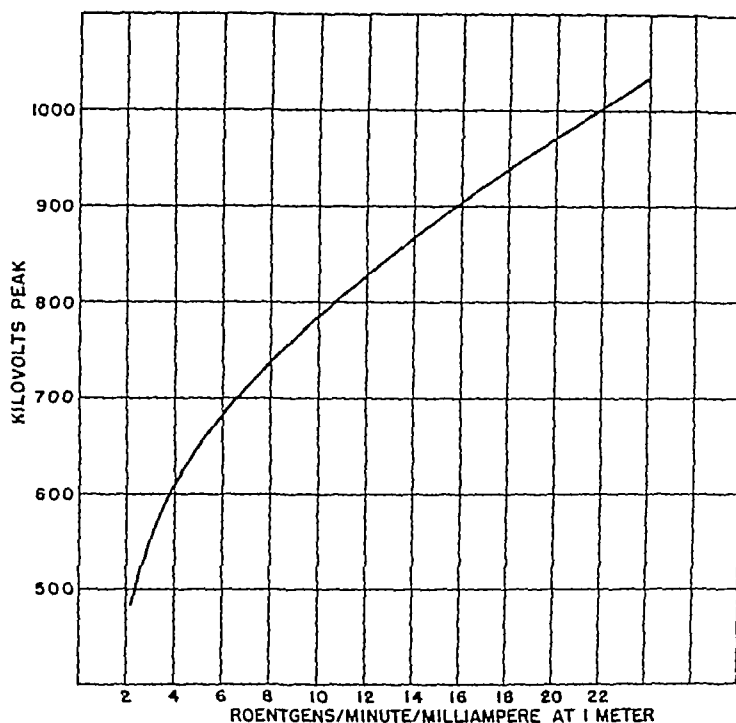


Fig 7 Roentgen ray output with low initial absorption for voltages of 500 to 1 000 kv

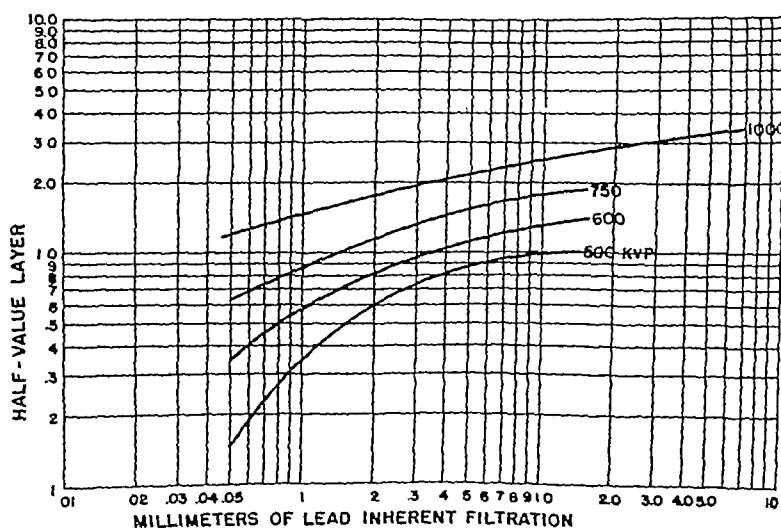


Fig 8 Graph for determining inherent filtration from half value layer in lead for voltages of 500 to 1 000 kv

previous papers referred to Earlier work of Taylor and Singer (6), Behnken and Nitka (7), and Thoraues (8) should be mentioned as contributing to the subject

SUMMARY

1 A million-volt sealed-off multisection tube with beryllium window is described

2 Roentgen-ray data obtained from the tube on the reflected beam for a voltage range of 500 to 1,000 kv are presented

3 A graph is given for determining inherent filtration of any roentgen-ray tube operating at as high a voltage as 500 to 1,000 kv when only the half-value layer in lead and operating voltage are known

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Experimental Clostridial Infections in Dogs¹

JAMES G VINCENT, B A, HELEN WHITGROVE VINCENT, M S, and ANDREW H DOWDY, M D
Rochester, N Y

THE WORK PRESENTED in this paper represents a chronological summary of approximately six years' experience with clostridial infections in 1,638 dogs. The objectives of the study were to determine the most practical and effective means applicable under conditions of war which would (1) prevent the occurrence of gas gangrene and (2) combat the disease once it had become established.

To accomplish the objectives as stated, the scope of the work was of sufficient magnitude to encompass a study of gas gangrene as produced by several of the most common clostridial organisms both in individual pure culture and mixed culture inocula. The efficacy of a given prophylactic² or therapeutic³ agent was then measured against the virulence of a given infectious agent or agents in the dog with the avoidance of unnecessarily complicating and variable factors. The design of the experiments was such as to minimize trauma and to exclude anesthesia and surgical techniques.

The degree and extent of interest and co-operation in the program are denoted by the accompanying list of participating groups and organizations. We are indebted especially to Dr M A Logan and his associate Dr A A Tytell of the University of Cincinnati, who prepared many of the preliminary toxoid preparations and who determined all of the alpha antitoxin titre levels on the dogs utilized in the toxoid experiments.

EXPERIMENTAL MATERIAL AND PROCEDURES

Infectious Agents The infectious agents used in producing the standardized clostridial

Participating Groups and Organizations

Department of Radiology, University of Rochester
J G Vincent
H W Vincent
A H Dowdy

Department of Surgery, University of Rochester
B V Favata
R L Sewell

Department of Biochemistry, University of Cincinnati
M A Logan } Toxoids
A A Tytell }

Department of Bacteriology and Immunology,
University of Rochester
C M Carpenter, Consultant

American Cyanamid Co
For sulfonamides

Lederle Laboratories (Division, American Cyanamid Co)
For antitoxin and toxoids

Merck & Co
For penicillin

Study carried out under contract with the Office of Scientific Research and Development

tridial infections in dogs are listed in Table I. Since the inocula were prepared from media containing chopped meat, the number of organisms per inoculum can be given only in approximation. No attempt was made to differentiate between the vegetative organisms and the readily germinating spores in the various inocula. However, the inocula so used, regardless of the clostridial species, were uniform in respect to the severity of the infections and to the fatalities in the control animals over the several years in which the experiments were carried out.

This consistency in the pathogenicity of

¹ From the Department of Radiology, the University of Rochester School of Medicine and Dentistry, Rochester, N Y. Presented by Dr Dowdy at the Thirty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec 1-6, 1946.

² Prophylactic as used throughout implies that the treatment agent was given prior to inoculation.

³ Therapeutic as used throughout implies that the treatment agent was administered subsequent to the inoculation.

TABLE I INFECTIOUS AGENTS

Nomenclature		Source of Culture	Amount of Inoculum	
Bergey	Medical Texts			
<i>Cl perfringens</i>	<i>Cl welchii</i>	S M H, † 1939	1.5 ml	Between 750 million and 1 1/2 billion
<i>Cl septicum</i>	<i>Cl septicum</i>	A T C C †† 8053	1.0 ml	Between 250 million and 500 million
<i>Cl novyi</i>	<i>Cl oedematiens</i>	P Long	0.5 ml	Between 50 million and 100 million
		I Hall, 140		
<i>Cl bifermentans</i>	<i>Cl sordellii</i>	I Hall, 9678	0.2 ml	Between 70 million and 100 million
Mixed culture 1* (<i>Cl welchii</i> , <i>Cl septicum</i> , <i>Cl sordellii</i> , <i>Staph aureus hemolyticus</i>)			0.03 ml	
Mixed culture 2** (<i>Cl welchii</i> , <i>Cl septicum</i> , <i>Cl sordellii</i> , <i>Cl oedematiens</i> , <i>Staph aureus hemolyticus</i>)			0.03 ml	
Mixed culture 3* (<i>Cl welchii</i> , <i>Cl oedematiens</i>)			0.2 ml	

* Approximately 30 times as virulent as would be expected from simple summation

** Approximately 40 times as virulent as would be expected from simple summation

† Strong Memorial Hospital

†† American Type Culture Collection

the infectious agents is substantiated by a survey of fatalities in the control animals. In the *Cl welchii* control animals there was an 86.8 per cent fatality in 129 control dogs in the period from 1941 to 1944. The 25 *Cl welchii* controls of 1942 showed an 88.0 per cent fatality with an average survival time of 39.5 hours. The 30 *Cl welchii* controls of 1944 showed a 90.0 per cent fatality with an average survival time of 49.2 hours. This agreement in fatalities was typical of the results obtained with the other clostridial infectious agents used, either singly or in combination (Table II).

TABLE II MORTALITY IN CONTROL DOGS (Over Five-Year Period)

Infectious Agent	No. of Dogs	Per Cent Mortality
<i>Cl welchii</i>	144*	89.5
<i>Cl septicum</i>	34	100.0
<i>Cl oedematiens</i>	65	98.4
<i>Cl sordellii</i>	34	91.1
Mixed culture 1	35	94.3
Mixed culture 2	99	100.0
Mixed culture 3	4	100.0
TOTAL	415*	94.9

Note: Total number of dogs studied (treated and untreated) 1638. There was only one dog out of the 1638 which did not develop the disease from the inoculum.

* This does not include the 25 control dogs with a smaller inoculum resulting in an 80 per cent mortality.

Douglas' medium (1) containing chopped heart and plugged with vaseline was used both for storage of the clostridia and for cultivation of the infectious inocula. The master cultures were grown at 37° C

for twenty hours and then stored at 5° C for at least three months before being used for subculture. The *Cl welchii* inocula were obtained from a twenty-hour subculture and used directly, without washing. The inocula for *Cl septicum*, *Cl oedematiens* and *Cl sordellii* were obtained from twenty-four-hour transfers of twenty-four-hour master subcultures and were also used directly. When *Staph aureus* was introduced into the inocula, the organisms were obtained directly from twenty-four-hour unwashed Douglas broth subcultures of a culture which had been stored at 5° C for one week. The *Staph aureus* master culture was stored on Douglas agar slants at 5° C.

The amounts of the various inocula were arrived at by a series of tests in which infections were produced which were fatal to the majority of control animals but not so overwhelming as to make them impervious to therapeutic agents.

The mixed inocula were obtained by combining equivalent fractions of the individual inocula and sometimes a small fraction of *Staph aureus*. The virulence of these mixed inocula was so enhanced that the inoculation dose of the mixtures had to be reduced to one-thirtieth of the size expected from a summation of the individual inocula. Tests proved that this thirtyfold increase in virulence was not due to the presence of *Staph aureus* but probably brought about by synergistic infectious relationships between

the individual clostridia growing in the infected tissues. The inoculating organisms were always grown in pure culture and combined just prior to inoculation.

Method of Inoculation The inoculum was always combined with one-tenth of its volume of 1:1,000 adrenalin chloride at the time of inoculation. The injection was made by passing a needle (18 gauge) deep into the thigh muscles of the right hind leg until bone was encountered, the inoculation area having been previously clipped and sterilized with iodine and alcohol.

Recovery of Infectious Agents from Wound Fluid Recovery of the infectious agents from the wound fluid could be routinely accomplished in the case of the pure culture infections but was very difficult to perform with any consistency in the case of the mixed infections. Of the numerous methods tried with the mixed infections, the separation of the clostridia in the wound fluid by means of graduated heat shock was found to be the most practical.

Prophylactic and Therapeutic Agents The prophylactic and therapeutic agents were as follows:

- 1 Roentgen rays
- 2 Oxygen gas
- 3 Oxygen gas plus roentgen rays
- 4 Sulfadiazine plus roentgen rays
- 5 Sulfadiazine
- 6 Sulfanilamide
- 7 Butyryl sulfanilamide
- 8 Sulfathiazole
- 9 Penicillin
- 10 Pentavalent antitoxin
- 11 Toxoid

The prophylactic agents were administered three hours before introducing the infection, while the therapeutic measures were initiated three hours post infection-inoculation.

The first phase of the work, in which *Cl. welchii* was the only infectious agent used, included treatments with roentgen radiation, intramuscular oxygen, and oral administration of sulfonamides both prophylactically and therapeutically (with the exception of butyryl sulfanilamide, which was given intramuscularly). Sul-

fadiazine also was used therapeutically in combination with intramuscular oxygen and roentgen radiation, and oxygen and roentgen radiation were combined in a series of treatments.

The irradiated dogs received treatments of 100 r (measured in air) once to twice daily for the first group and twice daily for the second group. A description of the treatments has been given in former papers (2, 3). The dogs in the first irradiation group received a smaller infection-inoculum and developed a less severe gas gangrene, as measured by survival rate, than the dogs in the second group.

Oxygen was administered intramuscularly first above the infection site and then into the tissues in the immediate vicinity of the inoculation. The administrations were made twice daily for a period of three days.

Sulfadiazine was administered by stomach tube in doses of 0.5 gm per kilo of body weight once daily for both the prophylactic and the therapeutic treatments. Sulfanilamide was administered by stomach tube in doses of 0.25 gm per kilo of body weight twice daily and was used for prophylaxis only. Prophylactic butyryl sulfanilamide was given intramuscularly in doses of 0.25 gm per kilo of body weight twice daily. These procedures are summarized in Table III. All survivals of the dogs in each experimental phase were based on a ten-day observation period. It was found that this period was entirely adequate to cover late fatalities in the tests.

The second phase comprised studies of the prophylactic value of the sulfonamides against individual clostridial species and against a mixed clostridial infection-inoculum. The therapeutic efficacy of sulfadiazine was also tested against the mixed clostridial infection, and pilot experiments on the prophylactic and therapeutic value of penicillin were carried out (Table IV).

In this second phase the sulfonamides were administered intravenously except for supplementary oral administration when sulfanilamide and sulfathiazole were employed. Sulfadiazine and sulfathiazole were administered intravenously as the so-

dium salts in a 5 per cent solution Sulfanilamide was administered intravenously *per se* in an 0.8 per cent solution The supplementary oral doses of sulfanilamide and sulfathiazole were given by stomach tube The attempt was made to maintain the sulfonamide blood levels as closely between 15 and 20 mg per 100 cc as possible for a period of seventy-two hours Figures 1, 2, and 3 show the sulfonamide

the blood levels represent the approximate maximal and minimal levels throughout the treatment As in the first phase, the prophylactic treatments were initiated three hours before infection-inoculation and therapeutic treatments three hours post infection-inoculation

In the pilot experiments on penicillin, administration of the drug was made by both the intravenous and intramuscular

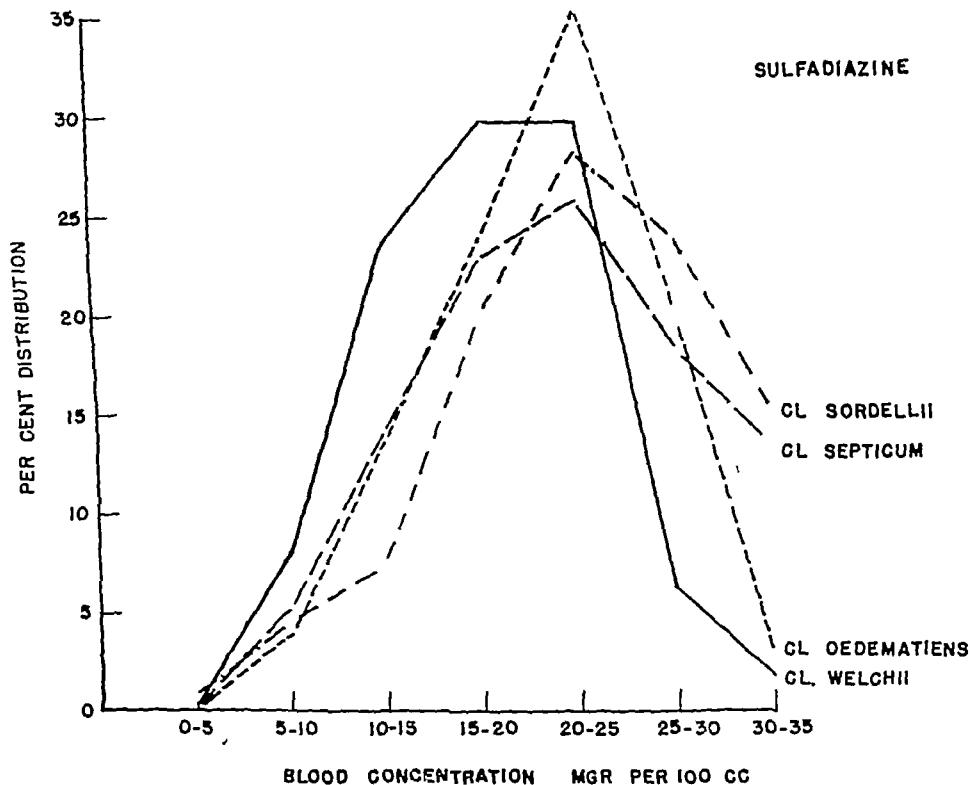


Fig 1 Blood concentration of sulfadiazine In this and the following graphs (Figs 2 and 3), the abscissa gives the blood concentrations in terms of milligrams per cent The ordinate gives the per cent distribution of the blood levels in the dogs during the course of the treatment

blood concentrations maintained by the various percentages of the experimental dogs over the course of the treatments It will be observed that it was possible to maintain a more consistent level with sulfadiazine, even without resorting to supplementary oral dosage, than with sulfathiazole, or sulfanilamide The blood levels were taken approximately one hour following the initial administration of the sulfonamide and then prior to and immediately following each intravenous drug administration Thus, in most instances

route The penicillin doses varied in these pilot tests from 300 units to 2,000 units per kilo of body weight

The mixed culture used in the second phase contained *Cl welchii*, *Cl septicum*, *Cl sordellii*, and *Staph aureus* but did not contain *Cl oedematiens*, since infections with this species were imperious to sulfonamide therapy

The third phase of the experimental procedure was devoted to therapeutic treatments of clostridial infections produced by mixed culture No 2 (*Cl welchii*,

Cl. septicum, *Cl. sordellii*, *Cl. oedematiens* and *Staph. aureus*) The definitive agents used were intravenous penicillin and intravenous pentavalent gas gangrene antitoxin (Lederle) The dosage and periods of duration of the treatments are given in Tables V and VII

Intravenous sodium sulfadiazine was used as an auxiliary agent in certain of the antitoxin and penicillin courses of therapy

to the customary pre-war clinical dosages, were employed These were only half the value of the later massive doses and were spread out over a considerably longer period The use of the massive dosage, administered over a shortened period, was arrived at after the preliminary experimentation

In the "half-treatments" where antitoxin and penicillin were given simul-

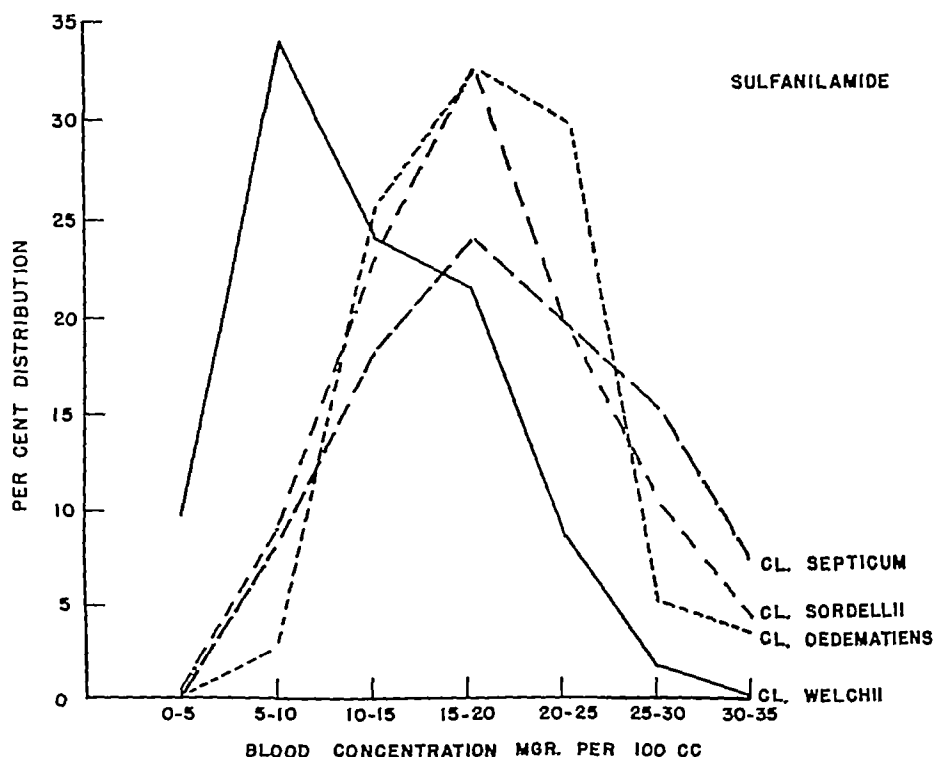


Fig 2 Blood concentration of sulfanilamide during treatment

for the reasons that (1) it would act directly upon the invading organism and (2) that its employment would more closely resemble battlefield conditions, where the wounded usually received routine sulfonamide administration The initial sodium sulfadiazine dose was 0.15 gm per kilo of body weight and administration was continued to maintain blood levels as nearly as possible between 15 and 20 mg per 100 cc

In a preliminary antitoxin experiment, lower dosages, corresponding fairly well

taneously, the individual periodic doses of both drugs were of the same value as those of the full treatments but administered for only one-half the regular treatment time

The interval between infection-inoculation and the initiation of antitoxin or penicillin therapy was varied from three hours to twelve hours to test the efficacy of the agents when introduced at early and late stages of the infection

The fourth phase of the work covers research on the protection afforded by

toxoid immunization against our standardized experimental clostridial infection in dogs. As mentioned above, this part of the work was carried on in collaboration with the Department of Biochemistry of the University of Cincinnati. The alum precipitated *Cl welchii* (perfringens) toxoid No 359H21A, 18.1 Lb, used for all but the preliminary tests, was furnished by Dr I. S. Danielson of the Lederle division of the American Cyanamid Co.

antitoxin titre range was necessary for this protection. Since the pilot experiments were of necessity of the hit-or-miss variety and since it was possible to carry through only with the more completely standardized *Cl welchii* toxoid, the results are not here reported.

The toxoid protection used in all of the tests except that in which a booster dose was employed was that afforded by a 1-ml inoculation of the No 359H21A *welchii*

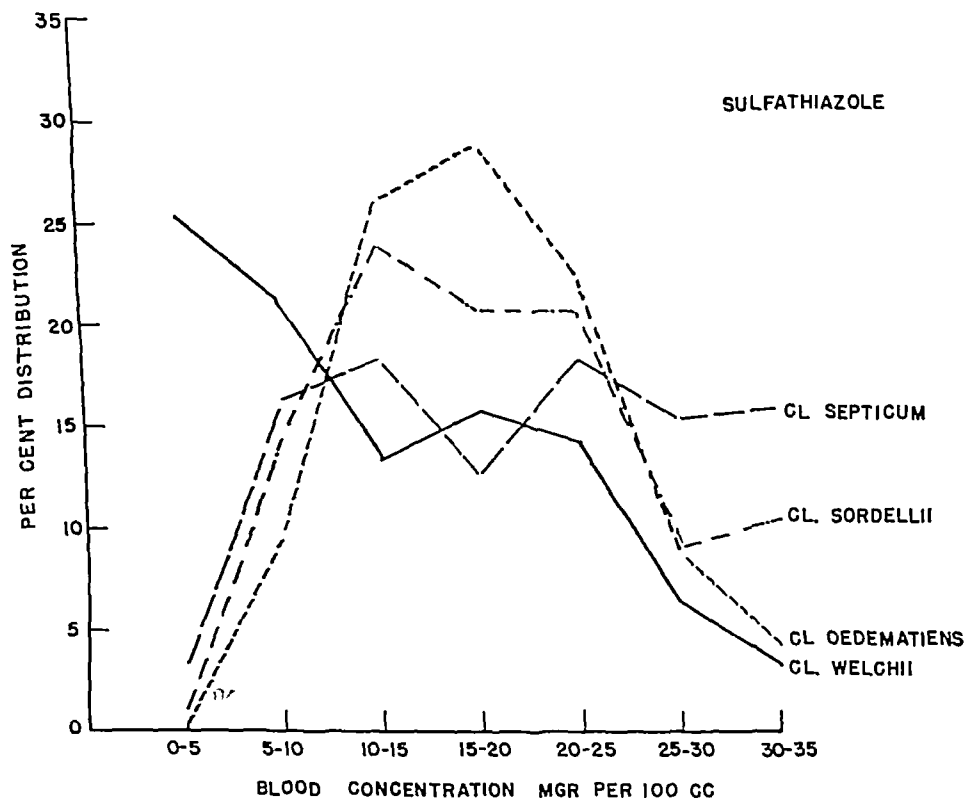


Fig 3 Blood concentration of sulfathiazole during treatment

All of the toxoid results reported in the accompanying tables were obtained with protection furnished by *welchii* toxoid against pure *Cl welchii* infections. Pilot experiments with other *Cl welchii* toxoids, with *Cl oedematiens* toxoid, with divalent *Cl welchii-Cl oedematiens* 1-1 combination toxoid, and with *Cl septicum* toxoid were performed for the purpose of discovering whether standardized clostridial infections in dogs could be used to challenge toxoid-induced protection and what

toxoid into the left hind leg of the dog twenty-one days before the infection challenge, which, as always, was introduced into the right hind leg.

The "natural" antitoxin titres referred to in the tables are naturally occurring alpha antitoxin titres present in the dog before immunization. The pre-challenge titres were obtained from blood samples taken immediately before inoculation of the infection-challenge. During the course of the infection, blood samples from the dogs

in two of the series were taken at 12-hour, 24-hour, 72-hour, 5-day, and 10-day intervals to determine the fluctuation of the titre during the course of the infection and to relate this fluctuation to the survival results (Tables XII and XIII)

In one of the series of *welchii* toxoid protected dogs, the toxoid protection was supplemented with the regular course of penicillin treatment initiated 12 hours post infection-challenge

In the booster dose toxoid experiment, the toxoid inoculation was divided into two 0.5 ml fractions and administered at 10-day intervals for a total immunization period of 20 days. The effect of using one toxoid inoculation to enhance the titre produced by a previous toxoid dose is illustrated in Table XI

Control Dogs In all of the phases of the experimentation, representative control animals were included to check each infection, and in the case of the mixed infections, controls on the individual clostridia were run along with the controls on the mixed inocula. A statistical analysis of the results obtained in phase two and three has been reported in a previous paper (4)

THE INFECTION PICTURE IN THE EXPERIMENTAL DOGS

The gas gangrene infections produced in the experimental dogs were severe and fulminating in character but not so overwhelming as to vitiate the therapeutic measures. The differences in the disease as produced by the several individual clostridial species were as follows

Cl. welchii Progress of the infection was very rapid. There were often some toxicity and moderate swelling of the involved leg within three hours after inoculation. Gas could usually be detected by palpation within three to six hours. The overlying skin rapidly took on a bluish-black appearance and serosanguineous seepage was often manifest within twelve hours. Approximately one-half of the control dogs died within the first twenty-four hours. Frank necrosis and sloughing were typical

in the controls that survived for any length of time. The final control mortality approximated 90 per cent

Cl. septicum The course of this infection was usually even more rapid than that of *Cl. welchii* infection. Gas was less prominent in the tissues, and pronounced erythema and early necrosis were typical. The mortality in all series of the controls was 100 per cent

Cl. oedematiens The course of this infection is relatively slow, particularly in regard to toxicity. The onset of swelling is prompt and it usually becomes extreme before death. Palpable gas was typically absent. The mortality of the control dogs approximated 100 per cent.

Cl. sordellii The infection was quite similar to that produced by *Cl. welchii* and *Cl. septicum* but was less rapid. There were swelling and discoloration of the involved limb, but little palpable gas was present. The mortality was practically identical with that of the *Cl. welchii* infection

Mixed Culture Infections The mixed culture infections were characterized by the greatly enhanced virulence already referred to and therefore had to be initiated with much smaller inocula. Each of the mixed culture infections had its particular manifestations as to virulence and course

Mixed culture No. 1, in which *Cl. oedematiens* was omitted, produced a slowly developing infection with only 20 per cent dead in the first twenty-four hours and an average survival time of fifty-six hours

Mixed culture No. 2, which included *Cl. oedematiens*, was considerably more rapid in its effect than No. 1, with an average survival time of thirty-four hours. The mortality was also slightly higher than with No. 1 for the same amounts of inocula

The infections produced by these mixed inocula were a composite picture of the infections produced by the individual inocula. Thus, with mixed culture No. 2, there were the rapid onset, considerable gas production, frequent pockets of serosanguineous fluid characteristic of *Cl.*

TABLE III FIRST PHASE X-RAY, OXYGEN AND ORAL PROPHYLAXIS
(Infectious Agent *Cl welchii*)

	No of Dogs per Experiment	Per Cent Survival
First x ray group (smaller infection inoculation)	25	36
Second x ray group	25	16
Intramuscular oxygen	25	24
Intramuscular oxygen and sulfadiazine	10	10
Intramuscular oxygen and x-ray	25	28
Prophylactic sulfadiazine (0.5 gm /k S T 1 X D)	25	88
Prophylactic sulfanilamide (0.25 gm /k S T 2 X D)	15	60
Prophylactic butyryl sulfanilamide (0.25 gm /k I M 2 X D)	10	30
Therapeutic sulfadiazine (0.5 gm /k S T 3 hr P I)	25	28
Therapeutic sulfadiazine and x ray	25	12
Control dogs no treatment	117*	16.2

* This includes a group of 25 control dogs having a smaller inoculum resulting in a 20 per cent survival

TABLE IV SUMMARY OF RESULTS WITH EXPERIMENTAL CLOSTRIDIUM INFECTION IN DOGS, JAN 1 1942-JAN 31 1943 SECOND PHASE
(All percentages based on ten-day survivals)

	Prophylactic						Therapeutic	
	<i>Cl welchii</i>	<i>Cl septicum</i>	<i>Cl oedematiens</i>			<i>Cl sordellii</i>	Mixed Culture*	<i>Cl oedematiens</i> (Long's)
			Long's Culture	Hall's Culture	Long's Reduced Inoculum			
Sulfadiazine	92%	72%	4%	0	36%	80%	88%	48%
Sulfathiazole	44%	28%	0			32%	80%	
Sulfanilamide	20%	0	0			40%	48%	
Penicillin (pilot experiments)			71.4%†					
Controls no treatment	12%	0	4%	0	20%	12%	6.6%	66.6%†

* Mixed Culture *Cl welchii* *Cl septicum* *Cl sordellii* *Staph aureus hemolyticus*

† Less than 25 dogs per group (pilot experiments)

welchii, and frequently the pronounced erythema of *Cl septicum* infection, particularly in the control dogs, as the infection progressed, the almost brawny swelling characteristic of the later stages of *Cl oedematiens* infection was superimposed on the softer swelling, the putrefactive odor of *Cl sordellii* was also characteristic of the infection. In the later stages, a pus-like fluid associated with *Staph aureus* was present.

RESULTS

First Phase The results for the first phase of the work are summarized in Table

III. It should be noted that part of these experiments are prophylactic and part therapeutic. None of the therapeutic results is highly significant as to the ratio of survivals between the control dogs and treated animals.

The differences between the percentages of survivals in the first and second x-ray groups are probably due to the smaller infection-inoculation in the first group, which would result in a more slowly developing infection and therefore one which might be more amenable to x-ray therapy. While the difference in fatalities between the series treated with x-ray only and that in which a combination of therapeutic sulfadiazine and x-ray treatment was used is slight, this result coincides with the supposition that x-ray and the sulfonamides are incompatible.

Second Phase Table IV shows the efficacy of prophylactic treatment with the sulfonamides against the individual clostridial infections and against mixed culture No 1. It might be pointed out that intravenous sulfadiazine maintained at blood levels approximating 15 to 20 mg per 100 c.c. gave about the same survival rate as prophylactic oral sulfadiazine administered to produce blood levels between 3 and 8 mg per 100 c.c. The higher blood level of sulfadiazine, however, produced a significantly greater therapeutic survival rate against mixed culture No 1 than the oral sulfadiazine used therapeutically pro-

TABLE V THIRD PHASE OF STUDY THERAPEUTIC
PENICILLIN DOSAGE
(Seventy-Two Hour Treatment Period)

1	First two doses at 2 hour intervals	2,000 Oxford units per kilo body weight
2	Third through 24th dose at 3 hour intervals	1,000 Oxford units per kilo body weight
Total dosage for 72 hours		26 000 Oxford units per kilo body weight
10 kilo dog	Total dosage, 260 000 Oxford units	
70 kilo man	Total dosage 1 820,000 Oxford units	

duced against *Cl welchii* infection. The time element is not comparable in the two instances, for when the sulfadiazine was given orally three hours post-inoculation, it required upward of four hours for the drug to reach maximum levels in the blood stream.

A careful study with two strains of *Cl oedematiens* has shown that the sulfonamides are ineffectual against this infection. The pilot experiments with penicillin suggested its use in the therapeutic studies of phase three.

While sulfadiazine proved to be far superior to the other sulfonamides as a prophylactic agent, its failure to counteract *Cl oedematiens* infections makes its value under battle conditions questionable (5).

The incidence of pathogenic clostridia in 164 known cases of gas gangrene in the Middle East Theatre is given by MacLennan (6). The incidence in 17 cases studied on the Italian front is cited by MacLennan and MacFarlane (7).

Third Phase *Cl oedematiens* was included in mixed culture No. 2 used in the third phase to test the therapeutic efficacy of penicillin and pentavalent antitoxin.

The data in Table VI demonstrate the effectiveness of therapeutic penicillin in combating the clostridial infections in early stages of the disease. As the disease develops, penicillin becomes progressively less effective. This is presumably due to its inability to control the toxemia which had established itself in twelve hours after infection-inoculation.

An *in vitro* test was set up to study the possible inactivation of penicillin by the direct action of *Cl welchii* toxin. Dilutions of alpha toxin to produce final con-

centrations of from 175 to 7 MLD were mixed with equal volumes of normal saline containing one unit of penicillin. These were tested against control dilutions of the toxin and saline, and penicillin and saline. Under the conditions of the test, the toxin was found to produce no direct action upon the penicillin.

TABLE VI THERAPEUTIC AGENT PENICILLIN
(DEFINITIVE)
(Infections Agent Mixed Culture 2)

Therapeutic Agent			No of Dogs per Experiment	Per Cent Survival
Penicillin	3 hr	post in-oculum	25	100
Penicillin	6 hr	post in-oculum	25	88
(Na Sulfadiazine 1 dose)	3 hr post-inoculum			
Penicillin	12 hr	post in-oculum	6	0 0
Penicillin	12 hr	post in-oculum	12	8 3
(Na Sulfadiazine 1 dose)	3 hr post-inoculum			
Penicillin	3 hr	post in-oculum	6	100
(Na Sulfadiazine 3 hr post-inoculum for 72 hr)				
No inoculum	Penicillin and Na Sulfadiazine for 72 hr (compatibility test)		2	100
Control dogs	No treatment		99	0 0
Mixed culture 2			36	0 0
Control dogs	No treatment			
Individual cultures which compose mixed culture 2				

The concentration of penicillin in the blood of representative infected dogs was tested from time to time by a filter paper disk modification of the Oxford cup method (8). This concentration was found to be rather variable with individual dogs and to diminish quite rapidly, indicating that the two- or three-hour administration intervals were necessary.

Sulfadiazine was found to be compatible with penicillin in gas gangrene therapy. However, its inclusion in the treatment was of doubtful value.

The therapeutic efficacy of antitoxin as summarized in Table VIII was excellent, whether administered early or late in the progression of the mixed infection. This, however, was true only of the massive doses administered over a shortened period.

Antitoxin was not as effective as penicil-

TABLE VII PENTAVALENT ANTITOXIN
(Massive Dosage Six-Hour Treatment Period)

1	<i>Cl welchii</i> antitoxin	2,000 units/kilo body weight*
2	<i>Cl septicum</i> antitoxin	2,000 units/kilo body weight*
3	<i>Cl oedematiens</i> antitoxin	300 units/kilo body weight*
4	<i>Cl sordellii</i> antitoxin	300 units/kilo body weight*
5	<i>Cl histolyticus</i> antitoxin	800 units/kilo body weight*

Total dosage in 6 hours

10 kilo dog, 80,000 *Cl welchii* antitoxin six hours
(others in vial proportions)70 kilo man, 560,000 *Cl welchii* antitoxin in six hours

* These dosages were given at two-hour intervals for 4 doses

lin in combating the local sepsis of gas gangrene. A combination of the two definitive agents appeared to approach the ideal treatment even when antitoxin and penicillin administrations were initiated at a late stage of the disease and limited to a "half-treatment" by each agent. The 88 per cent survival (Table VIII) of the combined antitoxin and penicillin group would have been somewhat higher except for the death of two dogs in that group from anaphylactoid effects. Inclusion of sulfadiazine in the antitoxin treatments appeared to be of little value.

The prophylactic efficacy of penicillin when administered early in war casualties is illustrated in a report by Fisher, Florey, Grimson, and Williams (9). The value of large antitoxin dosage as early as possible in the disease, with adequate accompanying surgical measures, is reported by MacLennan and MacFarlane (10).

Fourth Phase The experiments on the protection afforded by *Cl welchii* toxoid No. 359H21A against the standardized *Cl welchii* infection brought out the evaluation of the critical alpha antitoxin level necessary for immune protection, the value of late penicillin therapy in combination with the toxoid protection, the effect of the booster toxoid dose in establishing greater immunity, the relation of the titre level during the course of the infection to recovery, and the comparison between adequate therapeutic antitoxin and adequate toxoid protection. These results are presented in Tables IX-XIV.

It was shown that an alpha antitoxin level of less than 0.1 titre units per ml. of blood produced only an approximate 50 per cent survival as against an approximate 100 per cent survival when the titres were 0.1 unit or over at the time of infection.

TABLE VIII THERAPEUTIC AGENT ANTITOXIN
(DEFINITIVE)
(Infectious agent Mixed Culture 2)

Therapeutic Agent	No of Dogs per Experiment	Per Cent Survival
Antitoxin 3 hr post-inoculum (smaller customary clinical dose)	8	62.5
Antitoxin 3 hr post inoculum (massive dose given within 6 hr.)	25	88.0
Antitoxin 12 hr post-inoculum	25	92.0
(Na Sulfadiazine 3 hr post-inoculum, 1 dose)		
Antitoxin 12 hr post inoculum	25	84.0
(Na Sulfadiazine 3 hr post-inoculum for 72 hr.)		
Antitoxin and Penicillin 12 hr post inoculum, half treatment by each agent	25	88.0
(Na Sulfadiazine 3 hr post-inoculum, 1 dose)		
Control dogs,* No treatment	99	0.0
Mixed culture 2	36	0.0
Control dogs,* No treatment		
Individual cultures which compose mixed culture 2		

* Control dogs, same as for penicillin

tion-challenge There was a direct relationship between the height of the titre level and the protection against severe infection.

Penicillin therapy initiated comparatively late in the infection (twelve hours post-infection challenge) did not lower the fatalities in the group of dogs having less than 0.1 alpha antitoxin titres. This result agrees with those obtained in the third phase, in which it was found that penicillin does not have much effect when administered late in well developed clostridial infections unless it is accompanied by adequate antitoxin protection. The penicillin, however, helped reduce the severity of the infection in the dogs having 0.1 titre unit or more of alpha antitoxin. The concentration of penicillin in the dogs' blood ranged from an average of from 2.0

TABLE IX. FOURTH PHASE EVALUATION OF CRITICAL ALPHA ANTITOXIN TITRE LEVEL
(85 Dogs Infectious Agent Cl welchii)

Pre Infection Challenge Alpha Antitoxin Titre	No of Dogs	Degree of Infection			Per Cent Survival
		Slight	Moderate	Severe	
Group I Titre less than 0 1	25	3	3	19	48
Group II Titre from 0 1 to 0 5	20	8	13	8	96 5
Group III Titre from 0 5 to 5 0	31	15	14	2	96 7

TABLE X COMBINATION OF TOXOID PROTECTION AND PENICILLIN* THERAPY

Pre Infection Challenge Alpha Anti- toxin Titre	No of Dogs	Degree of Infection			Per Cent Survival
		Slight	Moderate	Severe	
Toxoid only					
Group I Titre less than 0 1	6	1	1	4	50 0
Group II Titre from 0 1 to 0 5	13	3	4	6	92 3
Group III Titre from 0 5 to 5 0	5	2	2	1	100 0
Toxoid plus penicillin					
Group I Titre less than 0 1	5	0	1	4	40 0
Group II Titre from 0 1 to 0 5	10	4	4	2	100 0
Group III Titre from 0 5 to 5 0	10	6	4	0	100 0

* Twelve hours post infection challenge

TABLE XI EFFECT OF BOOSTER DOSE OF TOXOID

Pre Infection Challenge Alpha Anti toxin Titre	No of Dogs	Degree of Infection			Per Cent Survival
		Slight	Moderate	Severe	
Single 1 ml dose (24 dogs)					
Group I Titre less than 0 1	6	1	1	4	50 0
Group II Titre from 0 1 to 0 5	13	3	4	6	92 3
Group III Titre from 0 5 to 5 0	5	2	2	1	100 0
Booster dose Two 0 5 ml doses at 10-day intervals (12 dogs)					
Group I Titre less than 0 1	1	0	0	1	100 0
Group II Titre from 0 1 to 0 5	2	1	1	0	100 0
Group III Titre from 0 5 to 5 0	9	7	2	0	100 0

TABLE XII TYPICAL ALPHA ANTITOXIN LEVELS (1 ML TOXOID INOCULATION)

Dog No	Type of Level	Alpha Antitoxin Titres							Result
		Natural Titre	Pre Challenge Titre	During Course of Infection Challenge					
				12 hr	24 hr	72 hr	5 days	10 days	
X73	Fluctuating	Less than 0 1	Less than 0 1	0 1-0 2	Less than 0 1	Less than 0 1	0 5	1 0-2 0	Recovered
X68	Fluctuating	0 2-0 5	2 0-5 0	2 0-5 0	1 0	1 0-2 0	More than 5 0	More than 5 0	Recovered
X54	Steady	Less than 0 1	Less than 0 1	Less than 0 1	0 2-0 5				Died in 29 hr
X62	Steady	Less than 0 1	0 2-0 5	0 2-0 5	0 2-0 5	0 2-0 5	1 0-2 0	More than 5 0	Recovered
X29	Steady	Less than 0 05	1 0-2 0	1 0-2 0	1 0-2 0	0 5-1 0	1 0-2 0	1 0	Recovered
X53	Continuous rise	Less than 0 1	Less than 0 1	0 2	0 2-0 5				Died in 72 hr
X56	Continuous rise	Less than 0 1	Less than 0 1	0 1-0 2	0 1-0 2	0 2-0 5	2 0	More than 5 0	Recovered
X66	Continuous rise	Less than 0 2	1 0-2 0	1 0-2 0	2 0-5 0	2 0-5 0	More than 5 0	More than 5 0	Recovered

TABLE XIII RELATION OF ALPHA ANTITOXIN TITRE CURVES TO PROGRESS OF THE INFECTION

Pre Infection Challenge Alpha Anti-toxin Titre	No of Dogs	State of Titre Level During Course of the Infection		
		No of Dogs	Degree of Infection	Per Cent Survival
Group I Titre less than 0.1	11	Fluctuating	Severe	50.0
		Steady	Severe	25.0
		Continuous rise	Moderate	60.0
Group II Titre from 0.1 to 0.5	25	Fluctuating	Moderate	92.8
		Steady	Moderate	100.0
		Continuous rise	Slight	100.0
Group III Titre from 0.5 to 5.0	13	Fluctuating	Slight	100.0
		Steady	Slight	100.0
		Continuous rise	Slight	100.0

TABLE XIV COMPARISON OF THERAPEUTIC ANTITOXIN AND TOXOID PROTECTION

Definitive Agent	No of Dogs	Degree of Infection			Per Cent Survival
		Slight	Moderate	Severe	
Inadequate therapeutic antitoxin dosage (4,000 units/k.)	8	1	1	6	65.5
Toxoid produced subcritical alpha antitoxin titres	25	3	3	19	48.0
Adequate (massive) therapeutic antitoxin dosage (8,000 units/k.)	25	9	9	7	88.0
Toxoid produced alpha antitoxin titres above critical level	60	23	27	10	96.6

to 2.5 Oxford units per ml at the maximum levels taken fifteen minutes after administration of the penicillin to minimum levels of from 0.062 to 0.125 unit per ml taken just before the administration of a repeat dose of penicillin (8).

The booster toxoid dose produced the greatest protection for the amount of toxoid used both as to the pre-challenge titre established in the dogs and their resistance to and recovery from the infection. There was a 100 per cent survival in this group.

The alpha antitoxin curves during the progress of the infection bore a direct relationship to the recovery of the infected animals. These titre fluctuations may be thought of as interrelationships between such factors as the degree of pre-challenge titre, the poise of the antitoxin immunity, the production of alpha toxin by the infection invasion, and the response of the immune system to antitoxin production from the stimulus provided by this invasion toxin. A continuous rise in the titre levels enhanced the probabilities of survival and the speed of recovery from the infection.

While the toxoid protection has been measured in terms of the alpha antitoxin

levels, the immunity so defined might be considered representative of immune protection against other toxins produced by *Cl welchii* infections. The theta antitoxin production from immunity established with *Cl welchii* toxoid No 359-H21A and the rise of the levels of theta antitoxin during the course of the infection were measured in representative dogs and found to be fairly comparable to those of alpha antitoxin.

A comparison of therapeutic antitoxin and toxoid protection indicates that these methods of combating the infection have quite similar effects. When the alpha antitoxin level was above the critical 0.1 unit, the toxoid immunization produced a slightly higher percentage of survival and a somewhat superior recovery from local sepsis and toxicity of the infection.

EFFECT OF LIVER SUPPLEMENT ON THE ANTITOXIN RESPONSE IN EXPERIMENTAL DOGS

An interesting relationship between diet and the pre-challenge titres produced by *welchii* toxoid was observed during the experiments on toxoid immunization (Table XV). Circumstances prevented

TABLE XV RELATION OF DIET TO PRE CHALLENGE TITRES PRODUCED BY WELCHII TOXOID

Distribution of Alpha Titres	Less than 0 1 u	0 1 u-0 5 u	0 5 u-2 0 u	2 0 u-5 0 u	Total Survival
Series I 24 dogs No liver supplement	13 dogs	3 dogs	4 dogs	4 dogs	66 6%
Distribution in titre groups	54 2%	12 5%	18 6%	16 6%	
Survival in titre groups	46 2%	100 0%	100 0%	75 0%	
Series II 24 dogs Liver supplement	5 dogs	14 dogs	4 dogs	1 dog	83 3%
Distribution in titre groups	20 8%	58 3%	16 6%	4 2%	
Survival in titre groups	40 0%	93 5%	100 0%	100 0%	
Series III 25 dogs Liver supplement	5 dogs	10 dogs	8 dogs	2 dogs	88 0%
Distribution in titre groups	20 0%	40 0%	32 0%	8 0%	
Survival in titre groups	40 0%	100 0%	100 0%	100 0%	

the use of a liver supplement to the diet in the first series of dogs immunized with *Cl welchii* toxoid No 359H21A. It was later observed in the animals receiving the liver supplement that there was a 2.6-fold decrease in the number with inadequate titre protection (under 0.1 unit). Except for differences in diet, the same methods of immunization were used for each series. The dogs were obtained from the same source of supply, received the same handling, had similar distribution as to size, age, and breed, and the time of the year in which the experiments ran was from late June to early October. As far as our data indicated, there was no correlation between worm infestation in these dogs and titre production. In earlier pilot experiments in which a cooked horse-meat supplement had been added to the diet, no differences in antitoxin response were apparent.

The dog meal fed routinely in the series without the liver supplement, and continued as a basic feed in the liver supplement experiments, was a typical dog chow (Field Trial Dog Chow). This meal had been used over the course of several years and had kept the caged dogs in good condition, usually producing gains in weight. The liver supplement used was pig's liver in a relatively fresh state, prepared for feeding by summing whole livers for approximately one hour and grinding, it was fed along with the broth. The dogs of average size received about one-half pound of the cooked and ground liver, with a proportionate amount of broth mixed with the dog meal, spread out over the feedings for a week.

An examination of Table XV will show that a certain number of the dogs in Series I, which did not receive the liver supplement still developed high titres on the regular dog chow. The effect of the liver supplement, therefore, was that of materially decreasing the number of dogs which could not develop adequate titres on the dog chow diet. This consideration suggests that the dogs with the inadequate titres may have failed to utilize a dietary element from the dog meal, an element which the liver supplement supplied to the later series. Topley and Wilson (11) cite a few examples in which vitamin variations in diet are reported to have modified antibody response. Hartley (12) describes experiments in which an addition of cabbage to the basal bran and hay diet of guinea-pigs produced a greater degree of immunity from diphtheria-formol toxoid than was obtained with a mangold supplement to the basal diet. In another publication, however, Hartley (13) found that a restricted diet did not affect the response of previously immunized guinea-pigs to fresh toxoid injections.

The relationship between diet and immunity is also affected by an adequate supply of protein in the diet to maintain the synthesis of antibody-globulin and to conserve the "intracellular globulin matrix" (P. R. Cannon, 14). Madden and Whipple (15) have shown that diet regulates globulin production in dogs. Cannon (16), in a later publication, showed that rabbits made hypoproteinemic by low-protein diets had a lessened capacity to produce agglutinins.

There was no evidence that the dogs used in the above experiments were hypoprotelemic, and as a whole they gave the appearance of being well nourished both with and without the liver supplement. This evidence on the relationship of diet to antitoxin production is presented as being suggestive of further investigation rather than as evidence that such relationships exist. It should be particularly pointed out that this diet relationship was apparent only in dogs with the relatively low titres produced by a single one-ml toxoid dose.

PATHOLOGY

For a detailed account of the pathology resulting from clostridial infections in dogs, the reader is referred to a previous publication limited to that subject (17). We shall confine ourselves at this time to a brief summary of the findings.

Careful pathological studies were conducted on 26 untreated control dogs and on 43 receiving one or more therapeutic or prophylactic agents, a total of 69 dogs. Autopsies were performed on representative animals selected from each experimental group as soon after death as possible. Most of the recovered dogs were sacrificed by intravenous nembutal and chloroform. All the organs except the brain and spinal cord were examined routinely. In four dogs dying of the infection, the brain and spinal cord were studied with negative results. In the control animals, the tissues and organs most involved were the muscles at the site of inoculation, the heart, and the liver, in the order named. The kidneys in both the control and treated animals were uniformly free from hemorrhage and necrosis.

The control dogs subjected to histologic examination were inoculated with individual cultures of *Cl welchii*, *Cl septicum*, *Cl oedematiens*, *Cl sordellii*, or a mixture of these four organisms plus *Staph aureus* (mixed culture No 2). In general, the animals in the control group using the mixed culture No 2 revealed a more severe damage than did the animals receiving a

pure strain of one of the clostridial organisms. It was impossible to determine any difference in the degree of damage resulting from the disease when produced by the various individual pure culture clostridia inocula. The pathology studies confirmed our clinical impression, in that they showed uniformly a severe infection with extensive damage at the site of the inoculation.

Microscopically, the muscle in the region receiving the inoculum was largely replaced by a diffuse mass of fibrin and degenerated red blood corpuscles. Many of the remaining muscle fibers revealed a loss of nuclei. The changes in the heart muscles were scattered throughout and consisted of areas of moderate to severe fragmentation of the muscle fibers with swelling, loss of striations, pallor, fine and coarse granular degeneration. Frequently scattered areas of Zenker's "waxy degeneration" of the muscle fibers were seen. In all instances the liver was markedly engorged with red blood corpuscles. Small areas of focal necrosis were noted in some instances.

In the successfully treated animals there was excellent recovery of the inoculated site. Some of the involved legs were practically normal in gross and microscopic appearance. The heart revealed only an occasional area of old necrosis with good organization. The few dogs dying as a result of the disease, despite prophylactic or therapeutic measures, manifested severe cardiac damage. In several, the liver was undamaged. Two of the dogs receiving antitoxin therapy died an anaphylactoid death.

CLINICAL APPLICATIONS

It has been pointed out that gas gangrene as produced in the dog is similar in character to a *fulminating* infection as seen in man. In general, the swelling and necrosis in the dog remain confined to the involved leg and the immediate surrounding tissues of the lower abdomen. The course of the disease is rapidly and progressively downhill in a very high percentage of the untreated animals as manifested

by a severe local reaction and a progressive general toxemia. Death presumably results from cardiac failure.

The dissimilarity in the production of the disease from that of the naturally occurring infection in man must be pointed out. The clinical disease as seen in man usually results from a few spores of one or more strains of clostridial organisms being carried into or beneath the skin with the accompaniment of clothing, dirt, or other contamination, as a result of some minor or major trauma. The trauma *per se* may be of sufficient magnitude to endanger life without a complicating fulminating infection. The vascularity of the involved part subsequent to the trauma is of vital importance and may in itself dictate the extent of surgical intervention. Irrespective of the injury, the spores are introduced in comparatively small numbers unaccompanied by exotoxins. The spores require a variable period to germinate into vegetative forms and, in turn, must form their exotoxins *in situ*. This sequence of events permits a variable length of time to intervene between contamination of the wound with the clostridial spores and the onset of the disease clinically. In some instances this incubation period may be as long as forty-eight to seventy-two hours. In the disease as produced in the dog, the variable and complicating factor of major trauma has been circumvented. The trauma is reduced to a needle puncture wound. The organisms injected are in large numbers (Table I) in the vegetative and spore state and are accompanied by a certain amount of exotoxin (unwashed cultures). It can readily be seen that in the dog the disease has its onset at the time of inoculation and without treatment usually progresses rapidly to a mortality of approximately 50 per cent within twenty-four to twenty-six hours.

Bearing these differences in mind, it is justifiable to point out certain clinical applications of this study. It has been demonstrated that prophylactic sulfadiazine when given systemically (orally or intravenously) in the presence of an ade-

quate circulation at the site of the primary involvement results in a high degree of protection against experimental infections in dogs produced by pure strain inocula of *Cl welchii*, *Cl septicum*, and *Cl sordellii* but is ineffective against two different pure strain inocula of *Cl oedematiens* (Table IV). It seems reasonable, under similar conditions, to assume a similar prophylactic value in man. During the latter half of this study we have seen only an occasional patient with gas gangrene. Perhaps the rather general prophylactic use of the sulfonamides has brought about this reduction in civilian practice. Once the infection was established experimentally, we found sulfadiazine rather ineffective as a therapeutic agent (Table IV). We would expect its clinical therapeutic value to be equivocal.

The study of penicillin was limited to its therapeutic aspects. In our hands it was found to be extremely effective when given early, prior to severe toxemia. It was effective against the disease when produced by mixed culture No. 2 or by a pure strain inoculum of *Cl oedematiens*. As would be expected, penicillin had no antitoxic effect and when given relatively late in the disease was not remarkably effective. The best results were obtained when massive doses were instituted prior to general toxemia (Table V).

Polyvalent antitoxin given in massive doses, over a period of six hours, proved to be effective when treatment was instituted as late as twelve hours after inoculation (Table VIII). Under these conditions it was quite remarkable as a therapeutic measure. In smaller doses it was unimpressive. In massive doses it did not prevent a variable degree of local sepsis. The combination of polyvalent antitoxin and penicillin was most effective in combating local sepsis and general toxemia. Clinically we can postulate that large doses of polyvalent antitoxin plus large doses of penicillin should be an effective means of treating the established clinical infection in man, provided the circulation is adequate at the site of the primary infection.

Residual cardiac damage in man, as reported by Sewell (18) and experimentally demonstrated in dogs, indicates that the sooner adequate antitoxin therapy is instituted, the less likelihood there is of a residual cardiac injury. Care must be taken to test the patient for sensitivity to the antiserum. Desensitization must precede the administration of therapeutic amounts of antitoxin.

Unpublished data⁴ indicate that human toxoid immunization with *Cl welchii* toxoid will produce alpha antitoxin titre of 0.1 unit, or more, per ml of blood. Experimentally we found this to be the critical level (Table IX). The infection-challenge dose given the dog exceeds by far that which would normally be encountered in man. We should expect adequate protection in man by this method of immunization.

The clinical measures indicated from the discussion are in no way contrary to the dictates of good surgery. They are not meant to replace surgical measures as indicated in the care of a patient with clinical gas gangrene. We have previously pointed out that surgical amputation should be dictated by the vascular bed and not by the infection. The experiments as designed merely measure the virulence of the infecting organisms against the effectiveness of the prophylactic or therapeutic agent or agents and the resistance of the infected host. The evaluation of the various factors involved was simplified by the establishment of experimental conditions which would result in no impairment of circulation at the primary site of infection other than that produced by the disease itself. There was no complicating anesthesia.

SUMMARY

It has been possible to reproduce repeatedly in a large number of dogs experimental clostridial infections which in many respects are remarkably similar to clinical gas gangrene as it occurs in man. The main points of difference are in the mode

of production and the progress of the disease, which is much more rapid in the dog. Prophylactically, sulfadiazine was found to be the most effective sulfonamide employed, though it was valueless against *Cl oedematiens*. Therapeutically, sulfadiazine was far from being routinely effective.

Penicillin, therapeutically, in massive doses early in the course of the disease gave excellent percentage survivals. It had no antitoxic properties and, when administered in small doses or late in the development of the disease, was not very effective.

Polyvalent antitoxin (Lederle) in massive doses administered rapidly (within a period of six hours) was effective even when administration was begun as late as twelve hours post-inoculation. Smaller doses given over a longer administration period were relatively ineffective. Massive doses did not routinely prevent varying degrees of local sepsis. A combination of polyvalent antitoxin and penicillin gave the best results when both per cent of survivals and reduced local sepsis were the criteria. Histologic examinations of the heart muscle in the control and treated animals would indicate that it is vital to institute adequate antitoxin therapy early in the course of the disease in order to reduce residual cardiac damage to a minimum.

Cl welchii toxoid immunization was successful in protecting dogs against a pure strain inoculum of *Cl welchii*. The degree of protection thus afforded was comparable to the results obtained following polyvalent antitoxin therapy. The critical alpha antitoxin titre was adjudged to be 0.1 unit per ml of blood.

An interesting relationship was observed between diet in dogs and the capacity to produce adequate protective antitoxin titres.

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⁴ Dr. Milan A. Logan (personal communication).

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DISCUSSION

Robert P Barden, M D (Philadelphia, Penna)
When one considers the magnitude and fundamental importance of this six-year experimental study, it is easy to understand how inadequate I feel in attempting to discuss it. The only thing I can do is to compare some of Dr Dowdy's results with clinical material reported in the litera-

ture based on battle experience. Most of what I have to say comes from an article by Langley and Winkelstein to which reference was made.

Dr Dowdy has indicated that the clinical conditions in which gas bacillus infection occurs in man are somewhat different from the experimental conditions under which he studied it and therefore he would be the first to agree that the therapy may be altered by the altered clinical state. He mentioned the role of the vascular system, the vascular supply. In a battle casualty the status of the circulation is the most fundamental portion of the evaluation as far as treatment goes. He did not, of course, attempt to evaluate that in his animals.

The paper I refer to is based upon 96 proved gas bacillus infections in an Evacuation Hospital in Europe. The authors' experience seemed to indicate that in these soldiers prophylactic measures—chemotherapy—were not particularly useful and it was concluded that the most important single factor in prophylaxis was the initial cleansing of the wound by the first aid man and the immediate bandaging and sanitary care which the wound received.

As far as therapeutic aspects go, it was found that sulfa drugs were useful in combating the secondary invaders, that penicillin was useful in large amounts because of its bacteriostatic action, and that antitoxin, as Dr Dowdy indicated, was extremely important in selectively blocking the effects of the toxin produced by the organisms, particularly the late effects on the heart and distant structures, so that by no means am I saving that chemical agents should be abandoned.

I believe, however, that in human material one must not rely entirely upon medical treatment but be guided by the experience of the surgeons who felt that adequate and early surgery was the most single important factor. Of course, the delay period in battle casualties is very important and the difference between treatment instituted three days after the wound and six days after the wound is tremendous. In the first instance, the deaths ran around 11 per cent and in the second instance as high as 50 per cent.

Being a radiologist I should say something, I suppose, about what this means in regard to radiation therapy. I am pretty well convinced that roentgen therapy is probably of no value and certainly should not be used in preference to any of these other measures that have been described. If one does use roentgen therapy at all, I think it extremely important to use it in multiple small doses, with an attempt, as with chemotherapy, to maintain a constant level. In other words, treatment every three four, possibly six hours by the clock. Otherwise, we might just as well not try to talk about it.

Dr Dowdy indicated that he had no explanation for the antagonism between sulfa drugs in

general and radiation therapy I don't know whether he has any theoretical explanation or not, but the question is one that we are constantly asked by referring physicians

J F Kelly, M D (Omaha, Nebr) I cannot agree with the essayist when he says that he doesn't think there is anything to the x-ray treatment of gas gangrene. Nor can I see why we should spend time on experimental studies as to the effects of x-rays when their value is so clearly proved clinically and when reports from so many sources are available in the literature. It is fifteen years since I first registered my opinion on this subject and it has been confirmed by my own experience and that of many others in the ensuing interval. I should like to show some pictures of a young patient who was injured on a Sunday morning. In spite of continued administration of penicillin, gas gangrene developed and the patient was comatose when I first saw her the following Thursday. I instituted x-ray therapy at once, and by the next Sunday the patient was out of coma and recovery eventually ensued. [A series of slides illustrated Dr Kelly's remarks]

Dr Dowdy (closing) In attempting to answer Dr Barden's question, I am unable to say why there is this incompatibility, but I believe that it exists, and our experimental results would tend to verify this. Dr Kelly has previously called our attention to this incompatibility of x-ray therapy and the sulfonamides.

With reference to Dr Kelly's remarks, I am well aware of the work which he has done. In

fact, my first stimulation in regard to this disease resulted from the papers which he published some ten to twelve years ago when I was still with Dr Doub in Detroit. This interest I carried with me to Rochester.

Some years ago we spent a considerable portion of our time looking for clinical cases of gas gangrene. It was customary for practically every case to receive roentgen therapy. In later years, however, we have recommended other types of treatment. In so doing, I believe we are correct.

In a recent paper, Dr Kelly has emphasized the fact that x-rays require several hours to take effect. With this we are in agreement. We have pointed out experimentally in our dogs that one of the most severe damages is to the myocardium. One of my associates, Dr Sewell, reported a case of gas gangrene which we had previously treated; this patient showed residual cardiac damage presumably resulting from his gas gangrene infection. Personally, if I had this disease, I would wish to be treated with large amounts of antitoxin plus penicillin. The earlier the antitoxin is given, in our opinion, the less likely is one to suffer chronic myocardial damage.

X-ray therapy is extremely beneficial in certain types of infection. We advocate it for post-partum mastitis, and at one time used it for the clinical treatment of gas gangrene. Experimentally with less severe infections, we have indicated that x-ray therapy is of some value. Even here it is not as efficacious as some of the other methods employed. In the future, it would seem that active human immunization will be possible, based on the work of Dr Logan.



A Study of Quality and Origin of Parasitic Radiation from the Target of an X-Ray Tube¹

LUCIEN MALLET and ROBERT MAURIN

Paris, France

WHEN AN IMAGE of the anode of an x-ray tube is obtained on a film placed before a lead diaphragm having an opening 1 mm in diameter, all parts of the anode are reproduced, as shown in Fig 1, thus indicating that they all emit x-rays. In the figure, zone A corresponds to that part of the tungsten target which receives the greatest bombardment of electrons, zone B represents the remainder of the tungsten target, and zone C the copper support,

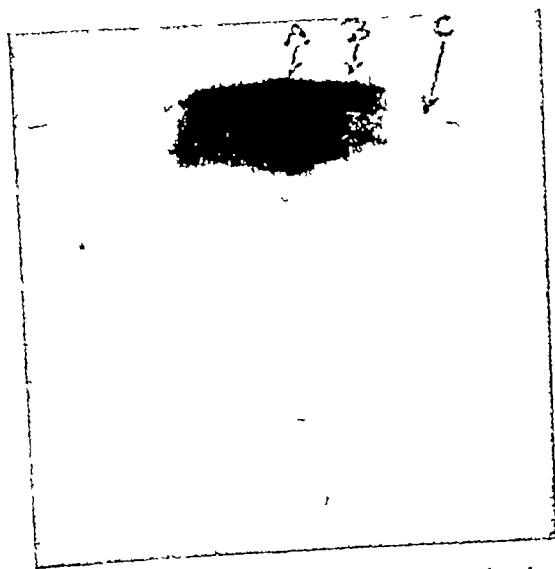


Fig 1 Image of the anode obtained through a diaphragm having an opening 1 mm in diameter. Zone A corresponds to the part of the target receiving the greatest bombardment of electrons, zone B to the remainder of the tungsten target, and zone C to the copper support.

or anode stem. The intensity and quality of the radiation emitted by each of these zones have been studied by three methods: (1) independent micro-ionization chambers, (2) the Strauss dosimeter, (3) blackening of an x-ray film.

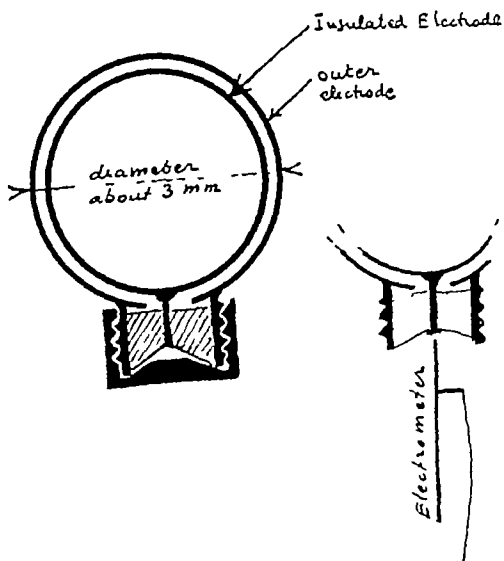


Fig 2 One type of independent ionization chamber used in the studies recorded here. Larger chambers on the same principle but of different form are adapted for therapy and for measurement of scattered radiation received by the workers.

(1) For the purposes of this study an ionization chamber measuring but a few millimeters in diameter was constructed. For the central insulated electrode and the outer electrode a substance of low atomic weight, as magnesium or some organic product, was used. The charge of the central electrode and the charge remaining after exposure are measured by means of a special electrometer providing an automatic charge, called by us "radiometre".

(2) The Strauss dosimeter measurements were made in accordance with the usual technique.

(3) The third method consisted in comparing the degree of blackening of an x-ray film with the aid of a densitometer, a standard scale of tints being used for quantitative determinations.

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With the micro-ionization chambers, it was found that at 100 kv the greater the diameter of the aperture in the lead diaphragm, the more penetrating was the radiation. This observation prompted us to investigate the influence of the different parts of the anode upon the quality of the

the radiation from the different zones, when the distance between the anode and the ionization chamber was 16 inches, was found to be as follows

Zone A	1 75 mm aluminum
Zone B	2 30 mm aluminum
Zone C	2 35 mm aluminum

The intensity of the radiation from zone A was 220 times that from B, while the intensity of the radiation from B was twice that from C. It does not follow, however, that zone B is responsible for only $1/220$ and zone C for only $1/440$ of the total radiation, since zones B and C are much larger than A. It is conceivable, therefore, that they may exert a notable influence on the quality of the radiation from any given tube.

When the limiting diaphragm used for the preceding study was withdrawn, the half-value layer at the same distance, *i.e.*, 16 inches, was found to be 2.0 mm

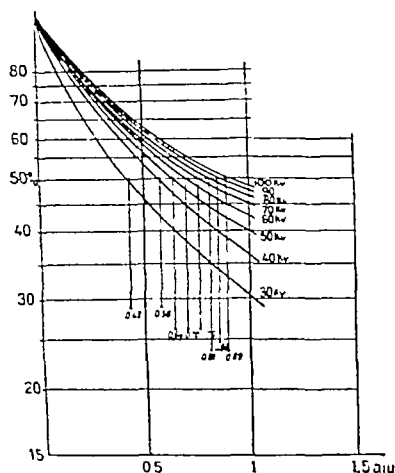


Fig 3 Curves showing absorption of the radiation (total) in aluminum at voltages of 30 to 100 kv at 30 cm distance from the anode. Ordinates Percentage of transmitted radiation. Abscissas Filtration in millimeters of aluminum

radiation. For this purpose the pin-hole diaphragm used to obtain the image of the anode was employed, the ionization chambers being placed successively in each of the three zones, A, B, and C. As will be explained more fully below, it was found that the radiation emitted by the central zone, A, was of the greatest wave length, while the most penetrating rays were those from zones B and C. These results were confirmed by densitometer determinations. The experiment was completed by a study of the effect of distance upon the quality of the radiation. It was found that with a large aperture in the limiting diaphragm, the radiation was most penetrating at the point of exit of the tube.

DETAILS OF EXPERIMENTAL STUDIES

(1) *Determinations with Micro-Ionization Chambers* With the specially constructed ionization chambers, the half-value layer of

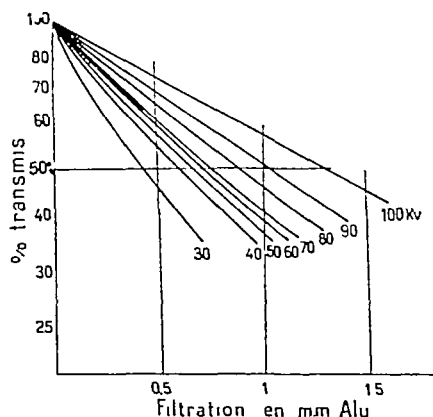


Fig 4 Curves showing absorption of the radiation (total) in aluminum at voltages from 30 to 100 kv at 8 cm distance from the anode. Ordinates Percentage of transmitted radiation. Abscissas Filtration in millimeters of aluminum

aluminum. This figure falls within the penetration range of zones A, B, and C. It represents, in fact, the total radiation from all three zones.

The difference between the quality of the radiation emitted by the central zone only and the total output was determined also for other distances. At 3

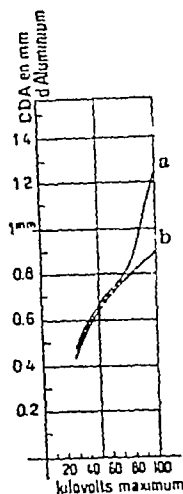


Fig 5 Variations in half value layer as a function of the maximum voltage applied to the tube at distances of 8 cm (a) and 30 cm (b). The curves are practically identical up to 70 kv but diverge sharply as the voltage is increased above that point.

inches from the target the half-value layer for a narrow beam of rays, issuing only from zone A, was shown to be 1.80 mm aluminum, but the half-value layer of the broad beam, representing all three zones, was 2.25 mm aluminum.

It is thus apparent that for the narrow beams, representing radiation from zone A alone, the quality is practically the same at 3 inches (h v l 1.80 mm Al) and at 16 inches (1.75 mm Al). For the broad beam, however, obtained without the diaphragm, there is a notable difference (2.25 mm Al at 3 inches, 2 mm Al at 16 inches).

Before attempting to interpret these observations, the results obtained with the other methods of study may be set forth.

(2) *Determinations with the Strauss Dosimeter* In this study the dimensions of the ionization chamber, which measures about 1 inch, precluded observations on narrow beams, and all measurements apply therefore to broad beams, without a limiting diaphragm. Figures 3 and 4 show the absorption in aluminum at 16 and at 3 inches, while Figure 5 shows the half-value layer in relation to voltage. It is seen in this last figure that for low volt-

ages the penetration at distances of 16 and 3 inches is the same, but at voltages above 70 kv the curves separate, the half-value layer at 3 inches (1.25 mm Al) being notably higher than at 16 inches (0.9 mm Al).

It will be noticed that at both distances the half-value layer as determined by the Strauss dosimeter is lower than that obtained with the micro-ionization chamber. This is to be explained by the fact that the specially constructed microchambers had an outer electrode of aluminum. Because of this, the less penetrating rays were

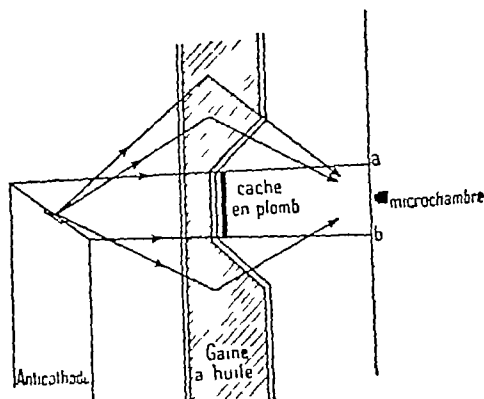


Fig 6 Measurement of scattered radiation with the tube exit covered with 3 cm. of lead and a thin sheet of aluminum.

eliminated and a much higher half-value layer was obtained.

(3) *Blackening of an X-Ray Film* By this method the half-value layer at 16 inches for 100-kv radiation with the limiting diaphragm was found to be as follows:

Zone A	1.10 mm Al
Zone B	1.50 mm Al
Zone C	1.70 mm Al

On withdrawal of the diaphragm we should expect, as with the micro-ionization chambers, to obtain a half-value layer within this range (1.10–1.70 mm Al). The figure actually, however, was 1.0 mm Al. This indicates that, when the diaphragm is withdrawn, there is added to the total output of the anode a very soft radiation scattered by the sides of the tube.

When ionization chambers are used for the measurements, this scattered radiation is largely eliminated by the walls of the chamber so that there is no lowering of the half-value layer of the total radiation

In order to study this scattered radiation, a film was placed 3 inches from the anode, the central opening of the tube was covered by a sheet of lead 3 mm thick and over this was placed a thin sheet of aluminum to eliminate the radiation scat-

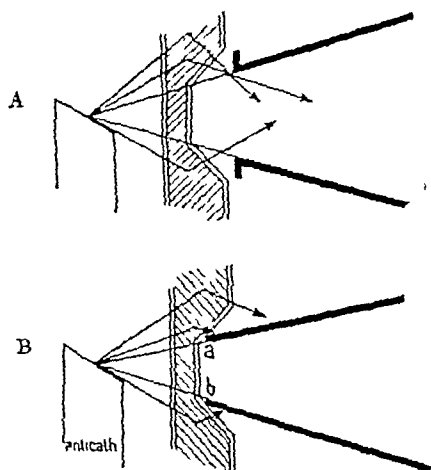


Fig 7 Effect of a localizing cone on the scattered radiation. This is eliminated only if the cone is in direct contact with the tube, as in B. When the cone is placed at a distance from the tube, as in A, the greater part of the scattered rays are transmitted

tered by the lead. With this arrangement, the radiation coming directly from the anode is suppressed completely for one part of the film, but the entire film receives the radiation scattered by the sides of the tube. This is shown in Figure 6, in which the area between *a* and *b* receives only the scattered rays. The half-value layer of this scattered radiation was found to be 0.5 mm Al.

The only way in which this scattered radiation may be eliminated is by placing a localizing cone directly against the tube, as in Fig 7 B. A similar cone at a greater distance, as in Fig 7 A, will be ineffective, as it will permit the passage of the greater part of the scattered rays.

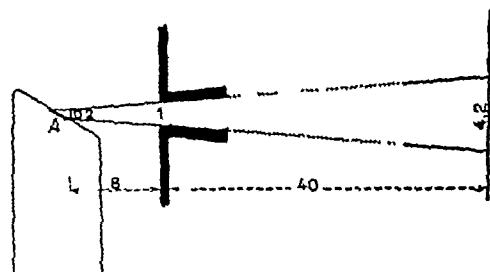


Fig 8 Showing the decrease in the field with reduction of the aperture in the cone. At 40 cm, for a 10 mm opening the field receiving the total radiation from zone A measures only 4.2 cm

The question arises whether a cone with a small opening might not be used to eliminate radiation issuing from zones B and C, allowing only the radiation from zone A to pass. As is shown by Figure 8, however, the aperture of the cone cannot be reduced

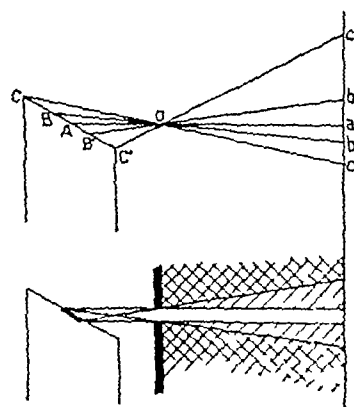


Fig 9 Series of images of a given point, O, due to the radiation from the three zones

without an altogether disproportionate reduction of the area of projection. Thus for a cone 1 cm in diameter in contact with the tube, the area of projection at a distance of 16 inches is less than 2 inches in diameter, considering, that is, the area of the film receiving radiation from the entire zone A.

The area of projection required for fluoroscopy and roentgenography demands a cone of such size that only a small fraction of the parasitic radiation from zones B and C is eliminated. As a result of this radiation, a series of shadows of any pro-

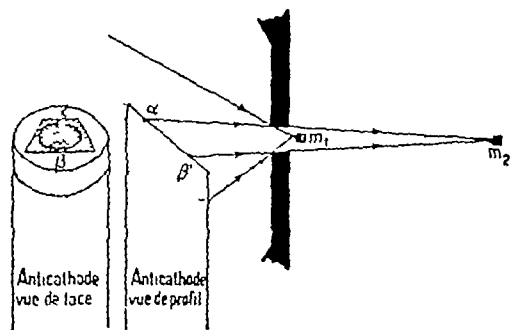


Fig 10 Diagram illustrating the quality of radiation at the point of opening of the tube (m_1) and at a distance (m_2)

jected point is produced, which results in diffusion of detail and consequent lack of definition in the image. This is shown in Figure 9, where O is the given point, a is the principal image, and b , c , b' and c' are the images due to the radiation from zones B and C. Since we cannot eliminate this parasitic radiation from the anode stem, we must reduce the metal volume of the latter as much as possible. The rotating anode has this advantage along with others.

DISCUSSION

It has been shown by the use of a diaphragm that the radiation emitted by zones B and C (Fig 1) is more penetrating than that from zone A. Without a diaphragm the radiation is most penetrating just against the exit of the tube. This may be explained by reference to Fig 10. In the figure, microchamber m_1 is placed just against the opening of the tube, where it receives radiation from almost all parts of the target and the anode stem. Microchamber m_2 , on the other hand, at a distance from the tube, receives chiefly radiation from zone A, without the more penetrating rays from zones B and C.

It remains to explain the greater penetration of the radiation from those parts of the anode at a distance from the principal focus, A, that is from zones B and C,

and the increase in penetration as this distance is increased. Electrons emitted by the cathode assume, as a result of the difference of potential between the filament and the anode, a kinetic energy which is a function of the difference in potential. The penetration of the radiation emitted by different parts of the anode bombarded by these electrons is, in turn, a function of their kinetic energy. It may be concluded, then, that the electrons striking zones B and C have a greater velocity than those reaching zone A, since the distance which they must travel to reach the point of impact is greater.

This fact can be explained by the repelling force (space charge effect) exerted by the electrons which reach zone A in high concentration, upon the electrons following behind them. Because of this, the sum total of electrons bombarding zone A have a lower velocity than would be expected if only the voltage applied to the tube were taken into consideration. Electrons bombarding B and C are not subject to this repelling force and therefore, falling upon these zones with their full velocity, produce a more penetrating radiation.

As noted as early as 1916 in a study of the early Coolidge tubes, given a constant voltage, the radiation becomes less penetrating as the intensity and, correspondingly, the concentration of electrons bombarding the anode are increased. It should be further noted that the degree of penetration increases with the distance of the source from the center of the tungsten target.

These phenomena have a significance for both radiography and radiotherapy that cannot be neglected.

NOTE This study was made in Paris at the Laboratoire de Radiobiologie du Centre Anticancerieux de l'Hôpital Tenon with a Picker X-ray Generator of the type used by the U. S. Army.

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Chronic Salmonella Bone Infection¹

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IT IS NOW GENERALLY recognized that systemic infection with organisms of the *Salmonella* group is not of rare occurrence. The literature abounds with reports of cases involving almost every system of the body. Most of the reported cases have been of the acute toxic type with severe constitutional reactions, and the patients have been chiefly infants and children. Few if any of the cases reported deal with the chronic form of the disease, *ie*, a localized pyogenic infection.

Recently we encountered an unusual example of chronic bone infection involving the lower end of the tibia which proved to be of the *Salmonella* type.

CASE REPORT

S S male age 20, was referred for x ray examination of the left ankle region. In 1940, while playing ball, he had twisted his ankle and it became painful and swollen. After a short course of baking and diathermy by his family physician the ankle became normal. Some six months later a similar episode occurred after slight activity, and this was repeated from time to time. In 1942, x ray studies revealed a cystic degenerative process involving the metaphyseal portion of the tibia and extending into the internal malleolus. In spite of this, the patient was inducted into the Armed Forces in 1943. While he was undergoing basic training the ankle suddenly became swollen and a cellulitis developed, requiring incision and drainage. After several weeks the lesion healed, and shortly afterward the patient was given a medical discharge. In April of 1945, while he was at college pain and swelling of the ankle again occurred spontaneously. He returned to his home and x ray studies again revealed cystic changes in the lower tibia.

The patient gave no history of any past acute infection, food poisoning, typhoid fever, or paratyphoid infection. Aside from a mild form of swollen glands in childhood, he had always been perfectly well.

A physical examination was negative except for the local findings. There were moderate soft-tissue swelling and redness about the ankle region with an old scar over the medial aspect of the ankle, the re-

sult of previous incision and drainage. Motion of the ankle was partially restricted in all directions and there was marked tenderness over the anterior and medial aspect of the lower end of the tibia.

X-ray examination revealed several irregular areas of cystic change in the lower end of the tibia extending into the internal malleolus. The larger cystic area was oval in shape, fairly well defined, presenting some reactive changes in the walls. The smaller absorptive areas were less clearly defined and showed only slight reactive changes. There was no expansion of the shaft, and the cortices appeared intact. The ankle joint was preserved. The impression was that of multiple small bone abscesses.

Differential Diagnosis Giant-cell tumor was considered in the differential diagnosis because of the location of the lesion in the metaphyseal and epiphyseal end of the tibia. The absence of trabeculation, together with the reactive process about the absorptive areas, tended to exclude this possibility. A tuberculous process was also considered and was difficult to exclude. The absence of demineralization and an intact joint militated against that diagnosis. A fibroma may present an appearance similar to that observed, but there is usually a single localized area of involvement with no particular reactive changes. Also, fibromata are not apt to be located in metaphyseal areas.

Operative Findings A 3-inch incision was made over the anteromedial aspect of the right tibia. The periosteum showed some thickening. On removing the cortex at a depth of about 1/2 inch, a caseous mass of tissue was encountered measuring approximately 3/4 inch. This was located about 2 inches above the internal malleolus. On continuing the bone dissection into the malleolus, three additional foci were opened up. The last of these was located near the ankle joint and contained three or four drops of fluid pus. At one point the lesion extended so close to the joint space that a small bit of cartilage of the joint was removed in opening up the focus. This cartilage measured about 1/8 inch in diameter. A smear and culture were taken and a specimen of tissue was removed for microscopic examination. The wound was closed in the usual manner, and a cast was applied.

Gross Pathology The specimen consisted of many fragments of spongy bone and some of cortical bone. Among the bits of tissue, one could find pieces of inflammatory membrane, some of which were free and some adherent to the spongy bone. Some of the spongy bone showed cavities containing whitish, almost chalk-colored, pus.

¹ Accepted for publication in September 1946.



Fig 1 Localized cystic changes in the lower end of the tibia

Microscopic Study Sections showed evidence of chronic osteomyelitis of a rather nondescript histologic nature. Some fields were heavily permeated with polymorphonuclear leukocytes and interspersed with macrophages some of which were filled with lipid. In other fields, the inflammatory cells in the marrow spaces were essentially lymphocytes and macrophages.

The diagnosis was chronic bone abscess. *Salmonella Oranienburg* was obtained on culture.

According to Seligmann and Saphra, about 38 different types of *Salmonella* have been identified. Some have been found rather infrequently, others seldom, a few only in a single instance. The predominant type is *Salmonella typhi murum* of group B, which occurs in 3 per cent of the cases studied. Next in frequency are members of group C—*S. Newport*, *S. cholerae suis*, *S. Oranienburg*, *S. Montevideo*, and *S. paratyphi B*. Forty-nine per cent of the *Salmonella* infections belong to group B, 33 per cent to group C, 6 per cent

to group D, and 6 per cent to group E. The other groups together account for 41 per cent.

In recent years the steady progress in the differentiation of the various types of *Salmonella* organisms and constant improvement in the methods of differentiation have broadened our knowledge and consequently our diagnostic acumen in this particular group of infections. Most of the cases are diagnosed by agglutination reactions with stock serum and proved by various culture methods. The National *Salmonella* Center, New York City, headed by Dr. Erich Seligmann, has done much to enhance our knowledge of the bacteriology and epidemiology of this group of organisms.

Salmonella Oranienburg is one of the paratyphoid group of organisms. The members of this group resemble each other closely, being gram-negative motile rods.



Fig 2 Cystic changes in the lower end of the tibia with extension into the internal malleolus

Differentiation by morphological cultural and sometimes even sugar fermentation methods is impossible. Agglutination by specific antisera and agglutination absorption are required for final differentiation.

Salmonella Oranienburg has been found in animals and human beings. It has the typical characteristics of *Salmonella* cultures in so far as it does not produce indol. It ferments under gas production, dextrose, maltose, and manitol. Furthermore, of the rarer sugars, it attacks arabinose, dulcitol, rhamnose, trehalose, xylose, but not inositol. It is able to utilize the different tartrates and citrates.

SUMMARY

A case is presented of chronic multiple bone abscesses of the lower end of the tibia which proved to be due to *Salmonella*. It is important to bear this organism in mind when dealing with chronic pyogenic infections of bone.

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Calcification of Pleura and Lung¹

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CALCIFICATION of the pleura or of the lung is not uncommon, but the massive involvement of an entire lung is so rare that the following case may be of interest. A few such lesions have been reported in the American and foreign literature, but none of these has been studied by body-section (planigraphic) roentgenography.

CASE REPORT

A white female of 74 years gave a history of diphtheria and scarlet fever in youth, pneumonia at 40 years, influenza at 42 years and pulmonary tuberculosis with pleuritis (hospitalization for one year) also at 42 years. The diagnosis of tuberculosis was confirmed by two sputum samples of separate date positive for acid fast bacilli. Symptoms at that time (1912) included cough, fever, and left thoracic pain. No thoracentesis or roentgen study was done.

There were two admissions to the Hospital of the University of Pennsylvania, in 1915 and 1924, because of pain in the left shoulder, thorax, and lumbar area, loss of weight, hoarseness, dyspnea, palpitation, and vertigo. At these times expansion was almost entirely right thoracic, tactile fremitus and vocal resonance were increased on the left above the 7th rib posteriorly. There were bronchial breath sounds, whispered pectoriloquy, depression of the supraclavicular fossa, and dullness to percussion on the left. The heart and trachea were constantly retracted to the left. On the second admission, the sputum was negative for acid fast bacilli and roentgen study of the chest revealed no expansion on the left, the heart retracted to the left lateral chest wall and left deviation of the trachea. Other findings were probable thickening of the pleura and pulmonary fibrosis and a suggestion of encroachment by emphysematous right lung upon the left hemithorax. (The plates were not available for review.) No mention was made of calcification.

From 1934 to 1945 the patient has been seen by Dr. O. H. Perry Pepper (to whom we are indebted for this report), as an outpatient. She has been in rather good health, suffering occasionally and moderately from cough, weakness, dyspnea, vertigo, sore chest or shoulder, and 'heart attacks'. However, these do not prevent her doing all her housework and driving a car.

DISCUSSION

High-speed Potter-Bucky roentgenograms in the postero-anterior and lateral projections reveal an extensive calcification in the left thorax and obscuration of the heart (Fig. 2, A and B). The contour of the upper and lower lobes can be seen well, and apparently both have undergone contraction with upward displacement. The right lung has expanded across the mid-line. The distance between the left rib cage and the calcium might be due to an uncalcified parietal pleura, but may be attributable simply to the fact that the shrunken lung lies posteriorly in the thorax and does not reach the lateral wall at its greatest diameter. This is analogous to a plan view of a spherical jar partly occupied by an opaque material (as in the accompanying sketch, Fig. 3).

Spiral laminagraphic exposures done in the anteroposterior and lateral projections reveal a diffuse homogeneous density throughout the left lung, and spotty, granular calcium placed irregularly (Figs. 4-13).

There has been a great deal of discussion in our clinic and among other roentgenologists and pathologists to whom we have shown these films. One group holds that the lesion is a calcification chiefly of the lung and also of the pleura, while the other maintains that this is principally a pleural calcification, with perhaps some small calcific lesions in the lung. Both agree fairly well that the lung has been the seat of severe contraction.

The theory that this is chiefly a lung lesion but also a pleural one is supported by the homogeneous density best seen in the planigraphic studies (Figs. 5, 6, 7, 11, 12, 13). Furthermore, the persistence

¹ From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in September 1946.

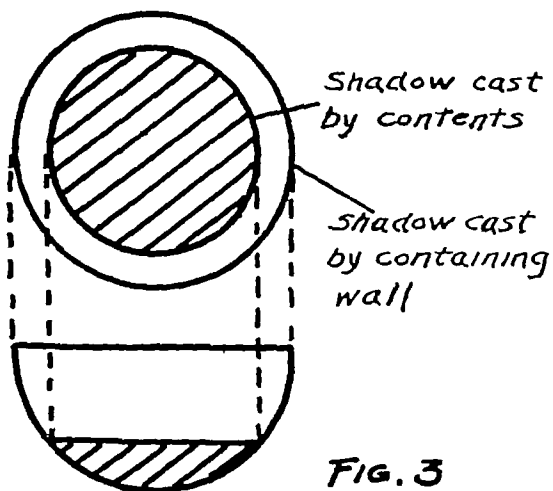
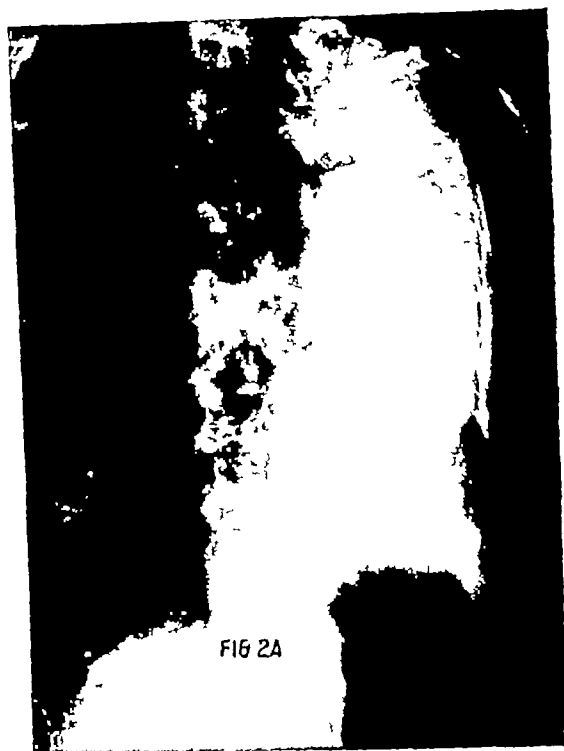
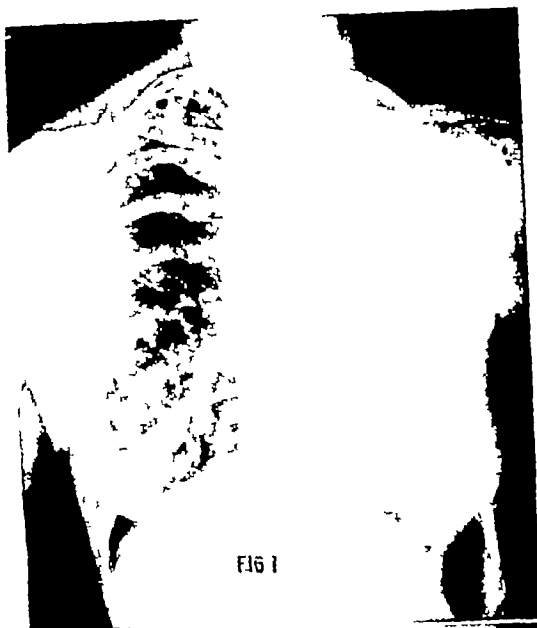


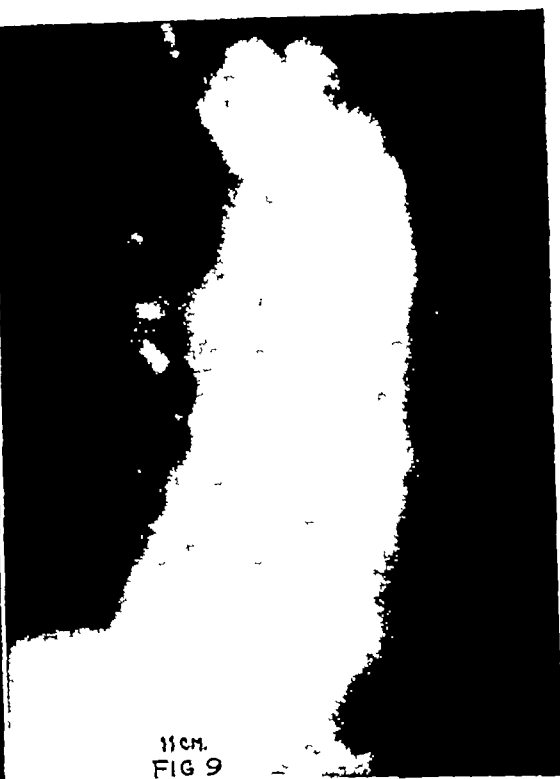
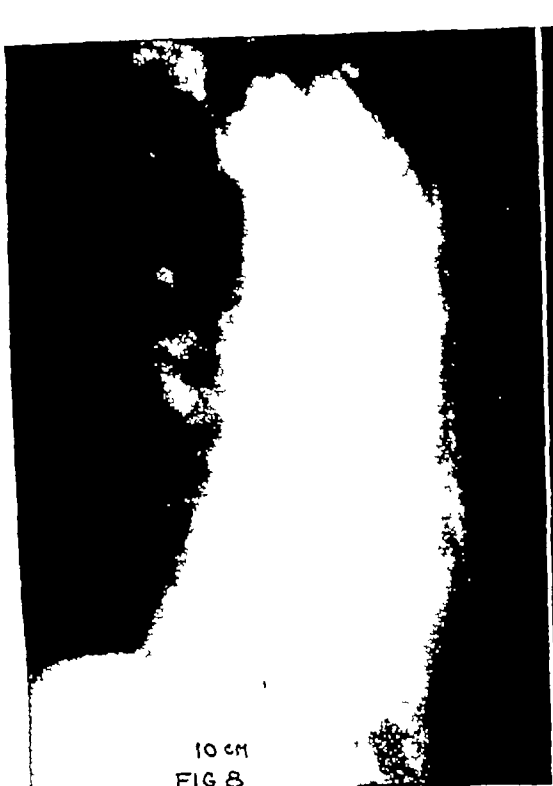
Fig 1 Standard non-Bucky film

Fig 2, A and B Bucky postero-anterior and lateral films

Fig 3 Sketch of partly filled vessel



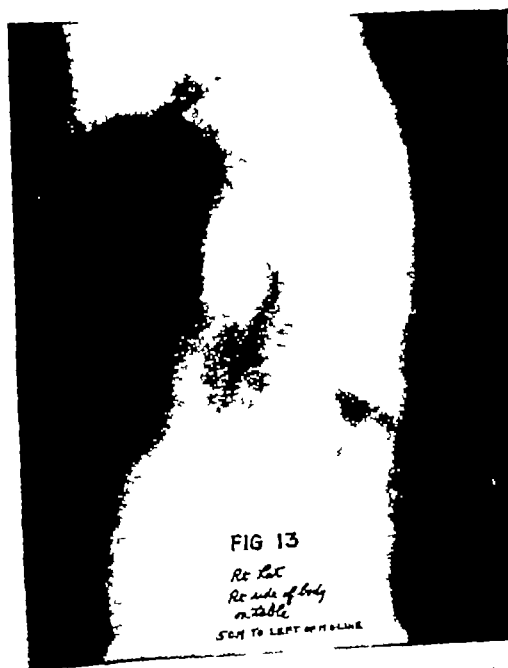
Figs 4-7 Planigraphic exposures anteroposterior of left side



Figs 8-10 Planigraphic exposures anteroposterior of left side

in many sections of the sharply outlined, dense, granular opacities within the periphery of the organ lends greater conviction to this view. The right lung also contains many discrete areas of calcium that are regarded as healed parenchymal tuberculous foci and there are probably similar lesions in the left lung. In addition, these proponents believe that, were the disease limited to the pleura, the great degree of contraction of the lung and herniation of the right lung into the left side would not be present.

On the score of this being principally a pleural lesion it is said that a densely fibrosed contracted lung and a probably thick hyaline pleura (underlying the calcium) would, very readily, provide a large degree of the homogeneous density seen. The adherents of this view believe that the dense granular areas lie along the pleural borders of the left lung and likewise in the right lung, that the planigraphic sections slice straight across the curving, constantly changing course of the lobar borders (in-



Figs 11-13 Planigraphic exposures lateral projection.

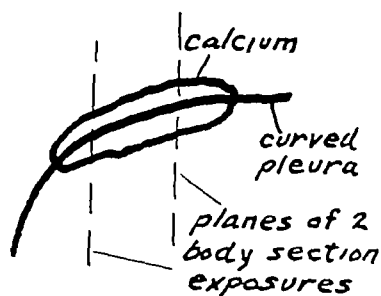


FIG 14

Fig 14 Two laminagrams on parallel planes may nearly duplicate each other and suggest location inside the lung

phenomenon causes many densities to be seen rather well at slightly changed locations as one proceeds from one to another of the planigraphic sections (Figs 4-13). If this pleural location is true, it will also cause the body sections to suggest or imitate a parenchymal location of the plaques of calcium (Figs 14 and 15).

Although this is a proved case of pulmonary tuberculosis, no necropsy study

cluding the interlobar pleura), where the dense patches may be seen located by the conventional Bucky films, and that this

can be presented, as the patient is living. However, this report does serve to reveal some methods and theories used and some limitations encountered in attempting to diagnose thoracic lesions roentgenographically.

NOTE Grateful acknowledgment is made to Dr O H Perry Pepper for his permission to publish this case.

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Fox Chase Philadelphia 11,
Penna

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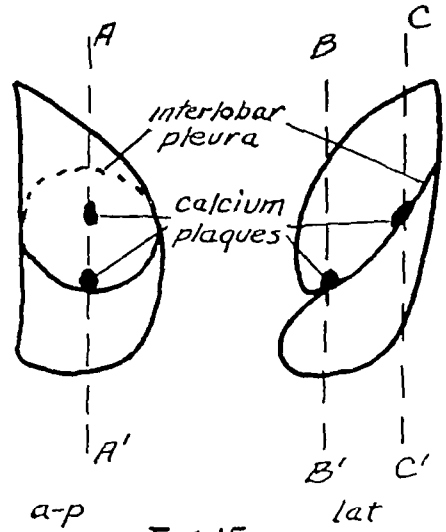
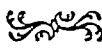


FIG 15

Fig 15 Sketch of anteroposterior and lateral projections to show how laminagraphic section A-A' will clarify two calcium bodies on the pleura but how sections B-B' and C-C' will cause areas to lie apparently within the lung

PRITCHARD, J S Some Interesting Cases of Calcareous Degeneration Found in the Thorax Arch Int Med 32 259-282 August 1923



EDITORIAL

The Present Status of Cancer Research

During the past three or four decades a tremendous amount of information has been acquired regarding the carcinogenic process. Up to the present time, search for a single cause of cancer has been fruitless. The great majority of modern cancer investigators will agree that the cause of cancer, unlike that of the communicable diseases, is complex and multiple. Cancer can now be induced at will in experimental animals by (a) more than 200 different chemicals, some of which are organ specific and induce the process in one organ or tissue only, (b) many of the energy agents (x-rays, ultraviolet light, gamma rays, etc.), especially when the tissues are subjected to interval exposures, (c) hormonal disturbances and imbalances, (d) genetic manipulations (inbreeding and cross-breeding), (e) a combination of one or more of the above factors. Recently, Copeland and Salmon¹ of the Alabama Polytechnic Institute have reported the induction of cancer in rats by means of a simple dietary (choline) deficiency.

While much has been learned about the inciting causes of cancer, which the late Dr. James Ewing called the "causal genesis," little or nothing has been discovered concerning Ewing's "formal genesis," or the intracellular changes that take place when normal cells are transformed into cancer cells. Some think this transformation is the same for all cancers. On the other hand, this mechanism, too, may be complex and multiple, and many theories have been advanced as to its nature. But regardless of whether the intracellular change is due to a somatic mutation, to an intracellular parasitic virus, to modified mitochondria as suggested by duBuy and

Woods², to a retrograde bacterium virus which has "hybridized" the cell, as suggested by Robert Green³, or to an altered protein enzyme as set forth by Potter⁴, the final result in every case is the same. We observe a deviation from the normal cell behavior-pattern in which cells contribute nothing to the organism as a whole but live at its expense and thrive while the rest of the body is wasting away. This is the concept regarding the nature of the cancer process toward which modern research has lead us. If it is correct, cancer may be thought of as an "autoparasite," or better perhaps an "autosite" (Gr *αὐτός*, self + *σῖτος* food). The latter term has been used in the past to designate a monster capable of an independent existence after birth or a member of a double fetal monstrosity that nourishes itself by its own organs and, also, by nourishment from the other member. There is a good reason to believe that some cancers, especially those of early childhood, differ from these monstrosities in degree more than in kind. While monstrosities invariably develop during intra-uterine life and are apparent at birth, the abnormal and equally monstrous growth we call cancer may occur at any time during the entire development (intra-uterine and post-natal) of the individual. Moreover, cancer, for reasons not yet clear, displays a tremendous jump in mortality after the age of 44. In 1940, the age specific death rate in the United States was 61.1 per 100,000 deaths for the age group 35 to 44, while it was 168.8 per 100,000 for the age group 45 to 54, and 1,183.4 for the age group 75 years and

¹ Science 102: 591, 1945.

² Biodynamica 6: 1-21, 1946.

³ Cancer Res. 3: 358-361, 1943.

⁴ Am. J. Path. 22: 1059-1079, 1946.

over⁵ "When the patient is over 40 think of cancer first" is a slogan that every conscientious physician will adopt when making a physical examination

Progress in the therapy of cancer has been relatively slow. Radium, x-rays, and surgery remain our most effective weapons provided diagnosis is made early and the patient falls in expert hands. Since World War II cancer research has been greatly accelerated in the United States. The American Cancer Society, upon the recommendations of the Committee on Growth of the National Research Council has allocated over \$1,500,000 to cancer investigations throughout the country, and the National Cancer Institute, upon the recommendations of the National Advisory Cancer Council, has distributed \$500,000 since July 1, 1946. Still larger sums from

both private and tax-supported sources will be available after July 1947. The emphasis today in cancer research is shifting from studies on the carcinogenic process toward chemotherapy. The recent advances made in our knowledge of the sex hormones in relation to the growth of certain types of cancer, the effect of nutrition (restricted caloric diet) on experimental animal cancers, both spontaneous and induced, and the discovery that certain chemicals seem to have selective effects on cancer cells have encouraged workers to concentrate upon the chemotherapeutic approach. No one can say, however, which approach is most promising, and the final solution may come from a totally unexpected source.

R. R. SPENCER, M.D.

*Chief of the National Cancer Institute
Bethesda, Md*

⁵ Illinois Cancer Bull 13, April 1946

Annual Meeting Radiological Society of North America

The Thirty-third Annual Meeting of the Radiological Society of North America will be held in Boston, with headquarters at the Hotel Statler, from November 30 to December 5, 1947.

GEORGIA RADIOLOGICAL SOCIETY

At the recent meeting of the Georgia Radiological Society, held in conjunction with the Medical Association of Georgia, Dr. Albert Rayle of Atlanta was elected president, Dr. Harry McGee of Savannah vice president, and Dr. Robert Drane of Savannah secretary treasurer.

Dr. Clarence Allen Goode, Jr., of the Mayo Clinic spoke on 'The Roentgenologic Diagnosis of Tumors of the Small Intestine'. Papers were also presented by Drs. L. P. Holmes, Stephen W. Brown, and David Robinson from the University School of Medicine, Augusta, Dr. James J. Clark of Atlanta, Dr. H. H. McGee of Savannah, Dr. Max Mass of Macon, and Dr. R. C. Pendergrass of Americus.

Arrangements were made to hold the mid-winter meeting of the Society at Tybee Beach.

PROFESSOR H. HOLTHUSEN

In the December (1946) issue of *RADIOLOGY* we were pleased to reprint some excerpts from a letter from Professor Holthusen of Hamburg, Germany. In a more recent letter, addressed to Dr. George Pfahler, Dr. Holthusen, acknowledging receipt of a Care package writes:

'While we are approaching the middle of March, we are still in hard winter. The snow lies higher than anybody can remember, the ice on the Elbe above Hamburg has more than one meter. From the coast you can drive in a motor car to the islands, a fact that never has been realized as long as his torical tradition exists. Since the middle of January the temperature only on two days in the past week has risen above zero. Fuel could not be delivered to the population and at the time being cannot even be transported to the electric power stations, so that in the evening, we generally sit in the dark. You can imagine what a value the supplementary calories of your gift represent in these extraordinary times as a compensation for the loss of warmth. But I confess they are the more welcome to us as we regard them as a token of your undiminished friendship to us.'

'We have passed these hard weeks in a comparatively good position, as we had warm room at home and as the hospital was comparatively well heated. It is only since the beginning of March that the supply of fuel has come to an end.'

'Not long ago we celebrated the 80th birthday of Prof. Walter. You remember perhaps his co-operation with Albers Schönberg in the field of Röntgen technique. He was a physicist and invented the water-cooled tube. He is still quite up to date and is to be found at his bureau at the Physical Institute nearly every day. Soon we are relying entirely upon the 'second generation'.'



Professor Adolf Liechti

In Memoriam

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1898-1946

In the death in August 1946 of Professor Liechti, head of the Central Radiological Institute of Bern University, the whole medical world has suffered a great loss as have all who had the privilege of knowing personally this modest, kindly man. Because of the illness which he bore with such admirable courage his appearance abroad was infrequent, but his pioneer work in every branch of radiology was known far and wide.

Under the direction of Hermann Holthusen, the leading German radiologist of the time there appeared in 1929 Liechti's standard treatise on the measurement of the quality and quantity of roentgen rays, a work which is still considered as the most important foundation of radiotherapy. Liechti's particular bent for physics was also seen in his creation of an entirely new type of combined electrocardiograph and x-ray apparatus, which makes possible specifically focused roentgenograms of the heart at any phase of cardiac activity, and in his

textbook on roentgen physics, probably the most authoritative work on the subject

But Liechti was in no sense interested in radiology solely as a branch of physics, he conducted radiobiological research with the same supreme ability which he brought to the solution of physical problems. It would be impossible to enumerate here even the more important of his works on radiobiology. The great services he rendered to medical radiology are no way less valuable. In the last stages of his illness he still carried on his work as a practising radiologist at several hospitals in Bern and his private institute, in addition to his university activities. All who had occasion to consult him were inspired with the deepest admiration of his personal qualities as well as his supreme knowledge of radiodiagnosis and radiotherapy. His last great work, *Radiodiagnosis of the Vertebral Column* (Springer, Vienna, 1944) was closely related to his own tragic affliction and, like all his works, is distinguished by a unique mastery of the subject.

Swiss radiology has indeed suffered an irreparable loss by the death of Professor Liechti. None will be able to fill his place. But all who knew and honored this unusual radiologist will feel themselves in duty bound to maintain his spiritual legacy, radiophysics, radiobiology and medical radiology, as equally important branches of radiology. Thus will the torch he set alight be carried forward. O HUBACHER
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Dr Smith's career was tragically cut short by an illness which began in 1936 and was slowly progressive until his death on Nov 20, 1946. His lingering illness was due to multiple sclerosis. Since 1939 he had been inactive in the Department of Roentgenology at Jefferson Hospital. In that year he married Marion E Bowers, who faithfully cared for him until his death.

Doctor Smith's career, though short led to his recognition by election to membership in the American College of Radiology, the American Roentgen Ray Society, the Radiological Society of North America, the Philadelphia Roentgen Ray Society, and the College of Physicians and Surgeons of Philadelphia. He was a member of Nu Sigma Nu and Sigma Alpha Epsilon fraternities.

Doctor Smith had made many friends during his work at Jefferson. His optimism in spite of his affliction, his great sense of humor, his accomplishments and friendliness all won him great admiration. His friends in radiology mourn his passing.

PAUL C SWENSON, M D

Book Reviews

RADIOLOGY FOR MEDICAL STUDENTS By FRED JENNER HODGES, M D, Professor and Chairman, Department of Roentgenology, University of Michigan, ISADORE LAMPE, M D, Associate Professor, Department of Roentgenology, University of Michigan, and JOHN FLOYD HOLT, M D, Assistant Professor, Department of Roentgenology, University of Michigan. A volume of 424 pages, with 103 plates. Published by The Year Book Publishers, Inc, 304 S Dearborn St, Chicago 4, Ill. Price \$6 75.

The expansion in the teaching of radiology has brought with it the publication of a number of textbooks, the latest addition by the University of Michigan group is a splendid contribution. Designed especially for the undergraduate student, the book fulfills admirably the purpose of the authors to furnish a well balanced succinct presentation of the subject. The attempt has been made to cover to a limited degree x-ray technic, to a reasonably elaborate degree roentgen diagnosis, and perhaps to an even greater degree than is really necessary for the undergraduate student, radiation therapy. The general principles underlying x-ray technic are well presented, although the details are not elaborated upon. The manner of reporting films is described fully and the one detailed report is a most satisfactory example.

There are few criticisms to offer on this excellent book. The information contained is entirely accurate and is presented in systematic fashion. The text is well written, the choice of illustrations is good and the whole manner of presentation is highly satisfying. A moderate sized, well selected bibliography is appended to each chapter. It would have been desirable to have included more detail on the specific indications for roentgen examination and on the evaluation of the results of x-ray examination in particular conditions. A serious omission is the absence of any discussion of the dangers of roentgen diagnosis both to the patient and to the physician and technician. While the deleterious effects of radiation are detailed in the section on radiation therapy, the dangers of prolonged fluoroscopy and of prolonged exposure of the workers in this field are not clearly delineated.

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This is a book which should facilitate the undergraduate teaching of radiology and should be most valuable for the student himself. It will also be helpful to the graduate student in this specialty as a short survey of the field and to the general physician who is interested in familiarizing himself with the accomplishments of modern radiology.

RADICAL SURGERY IN ADVANCED ABDOMINAL CANCER By ALEXANDER BRUNSCHWIG, M.D., Professor of Surgery, University of Chicago. A volume of 327 pages, with 118 illustrations. Published by the University of Chicago Press, Chicago, Ill., 1947. Price \$7.50.

Dr. Brunschwig is one of the leading exponents of a trend in surgery toward the performance of radical and extensive procedures in the presence of cancer, even though the prognosis for ultimate survival is admittedly poor. His book is a report of 100 consecutive cases of abdominal carcinoma, with extension and/or metastasis to the extent that they could reasonably be considered inoperable. All were treated by what the author terms "massive resection."

The unsuccessful cases are given as much prominence as the good ones, so that the reader can form his own opinion of the value of this kind of radical surgery. The immediate operative mortality was 34 per cent, and 17 per cent of the patients received no palliation. The other half were benefited, since 30 per cent received palliation and 19 per cent had a prolonged survival time. Of the latter, 13 per cent were living and well an average of forty months after the operation.

Some examples of operations are: removal of the entire stomach, spleen, transverse colon and body and tail of the pancreas for carcinoma of the stomach; removal of the right half of the colon distal half of the stomach, and periumbilical region of the abdominal wall for carcinoma of the colon; removal of all of the stomach, all of the pancreas, all of the

duodenum, spleen, omentum and left adrenal for carcinoma of the pancreas.

There are chapters on the history of cancer surgery, general considerations of operability, and the supportive treatment which is necessary in conjunction with radical surgery. The importance of adequate blood replacement is adequately stressed; it was not unusual for 2 or 3 liters of blood to be given while the patient was on the table.

The book is illustrated by clear photographs of the resected specimens and attractive diagrams which show what was done.

CONFRONTATIONS RADIO ANATOMO CLINIQUES. Published under the direction of M. CHIRAY, R. A. GUTMANN, and J. SÉNEQUE. Fascicule 1. A volume of 56 pages, with 98 figures. Published by Masson & Cie, Editeurs, Paris, 1946. Price 370 fr.

Thirty reports of cases, beautifully illustrated, make up this first issue of a new French publication. The object, as set forth in the Introduction, is not to duplicate the radiologic atlas or the specialized review, but rather to serve as a reflection of the "hasards de la clinique." The plan is to present individual cases, both classical and atypical, along with the films which have made possible a diagnosis or—what may sometimes be even more useful—have led to an erroneous conclusion. Where desirable, photographs of operative specimens and histologic preparations will also be included.

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RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

Editor's Note Secretaries of state and local radiological societies are requested to cooperate in keeping this section up to-date by notifying the editor promptly of changes in officers and meeting dates Address Howard P Doub, M D , The Henry Ford Hospital Detroit 2 Mich

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA *Secretary-Treasurer* Donald S Childs, M D , 607 Medical Arts Bldg , Syracuse 2 N Y

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F Hare M D , 605 Commonwealth Ave Boston 15, Mass

AMERICAN ROENTGEN RAY SOCIETY *Secretary* Harold Dabney Kerr, M D , Iowa City, Iowa

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F Cahal, 20 N Wacker Dr , Chicago 6, Ill

SECTION ON RADIOLOGY, A M A *Secretary*, U V Portmann, M D Cleveland Clinic, Cleveland 6, Ohio

Alabama

ALABAMA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John Day Peake, M D , Mobile Infirmary, Mobile Next meeting at the time and place of the Alabama State Medical Association meeting

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY *Secretary*, Fred Hames M D , Pine Bluff Meets every three months and annually at meeting of State Medical Society

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY *Secretary*, D R MacColl, M D 2007 Wilshire Blvd , Los Angeles 5

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION *Secretary* Moris Horwitz M D , 2009 Wilshire Blvd , Los Angeles 5 Meets second Wednesday of each month at County Society Bldg

PACIFIC ROENTGEN SOCIETY *Secretary* L Henry Garland M D 450 Sutter St , San Francisco 8 Meets annually with State Medical Association

SAN DIEGO ROENTGEN SOCIETY *Secretary* R F Niehaus M D , 1831 Fourth Ave San Diego Meets first Wednesday of each month

X RAY STUDY CLUB OF SAN FRANCISCO *Secretary* Ivan J Miller M D 2000 Van Ness Ave Meets monthly on the third Thursday at 7 45 P M January to June at Lane Hall Stanford University Hospital and July to December at Toland Hall University of California Hospital

Colorado

DENVER RADIOLOGICAL CLUB *Secretary* Washington C Huyler, M D Mercy Hospital 1619 Milwaukee Denver 6 Meets third Friday of each month at the Colorado School of Medicine and Hospitals

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY SECTION ON RADIOLOGY *Secretary*, Robert M Lowman, M D , Grace-New Haven Hospital, Grace Unit, New Haven Meetings bimonthly, second Thursday

Florida

FLORIDA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maxey Dell, Jr, M D , 333 West Main St , S Gainesville

Georgia

GEORGIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Robert Drane, M D De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

Illinois

CHICAGO ROENTGEN SOCIETY *Secretary*, T J Wachowski, M D , 310 Ellis Ave , Wheaton Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8 00 P M

ILLINOIS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, William DeHollander, M D , St Johns' Hospital, Springfield Meetings quarterly as announced

ILLINOIS STATE MEDICAL SOCIETY SECTION ON RADIOLOGY *Secretary* Frank S Hussey, M D , 250 East Superior St , Chicago 11

Indiana

INDIANA ROENTGEN SOCIETY *Secretary-Treasurer*, J A Campbell M D , Indiana University Hospitals, Indianapolis 7 Annual meeting in May

Iowa

IOWA X RAY CLUB *Secretary*, Arthur W Erskine M D , 326 Higley Building Cedar Rapids Meets during annual session of State Medical Society

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer* Sydney E Johnson, M D 101 W Chestnut St Louisville

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer* Everett L Pirkey, Louisville General Hospital Louisville 2 Meets second Friday of each month at Louisville General Hospital

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer* Johnson R Anderson M D No Louisiana Sanitarium Shreveport Meets with State Medical Society

This is a book which should facilitate the undergraduate teaching of radiology and should be most valuable for the student himself. It will also be helpful to the graduate student in this specialty as a short survey of the field and to the general physician who is interested in familiarizing himself with the accomplishments of modern radiology.

RADICAL SURGERY IN ADVANCED ABDOMINAL CANCER. By ALEXANDER BRUNSCHWIG, M D, Professor of Surgery, University of Chicago. A volume of 327 pages, with 118 illustrations. Published by the University of Chicago Press, Chicago, Ill., 1947. Price \$7.50.

Dr. Brunschwig is one of the leading exponents of a trend in surgery toward the performance of radical and extensive procedures in the presence of cancer, even though the prognosis for ultimate survival is admittedly poor. His book is a report of 100 consecutive cases of abdominal carcinoma, with extension and/or metastasis to the extent that they could reasonably be considered inoperable. All were treated by what the author terms 'massive resection'.

The unsuccessful cases are given as much prominence as the good ones, so that the reader can form his own opinion of the value of this kind of radical surgery. The immediate operative mortality was 34 per cent, and 17 per cent of the patients received no palliation. The other half were benefited, since 30 per cent received palliation and 19 per cent had a prolonged survival time. Of the latter, 13 per cent were living and well, an average of forty months after the operation.

Some examples of operations are: removal of the entire stomach, spleen, transverse colon and body and tail of the pancreas for carcinoma of the stomach; removal of the right half of the colon, distal half of the stomach, and periumbilical region of the abdominal wall for carcinoma of the colon; removal of all of the stomach, all of the pancreas, all of the

duodenum, spleen, omentum and left adrenal for carcinoma of the pancreas.

There are chapters on the history of cancer surgery, general considerations of operability, and the supportive treatment which is necessary in conjunction with radical surgery. The importance of adequate blood replacement is adequately stressed; it was not unusual for 2 or 3 liters of blood to be given while the patient was on the table.

The book is illustrated by clear photographs of the resected specimens and attractive diagrams which show what was done.

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Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer* James M Converse M D, 416 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, Calvin L Stewart, M D, Jefferson Hospital Philadelphia 7 Meets first Thursday of each month at 8 00 P M, from October to May in Thomson Hall College of Physicians 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, Lester M J Freedman, M D, 415 Highland Bldg, Pittsburgh 6 Meets second Wednesday of each month at 6 30 P M October to May, inclusive

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, A M Popma, M D, 220 N First St Boise Idaho

South Carolina

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft M D 103 Rutledge Ave, Charleston 16

Tennessee

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, J Marsh Frère M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary*, X R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, R P O'Bannon, M D, 650 Fifth Ave., Fort Worth 4

Utah

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, M Lowry Allen, M D, Judge Bldg, Salt Lake City 1 Meets third Wednesday January, March May September November

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE *Secretary* Henry H Lerner, M D Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital

Virginia

VIRGINIA RADIOLOGICAL SOCIETY *Secretary* E Latan Flanagan, M D, 215 Medical Arts Bldg, Richmond 19

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Frederic E Templeton, M D, 324 Cobb Bldg, Seattle 1 Meetings fourth Monday, October through May, at College Club Seattle

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer*, C A H Fortier M D, 231 W Wisconsin Ave, Milwaukee 3 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, S R Beatty, M D, 185 Hazel St, Oshkosh Two-day meeting in May and one day at annual meeting of State Medical Society in September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 to 5 P M, September to May, inclusive, Room 301, Service Memorial Institute, 426 N Charter St Madison 6

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford, M D, 2100 Marlowe Ave, Montreal 28 Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M D Institut du Radium, Montreal Meets on third Saturday of each month

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes Havana Meets monthly

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary* Dr Dionisio Pérez Cosío, Marsella 11, México, D F Meetings first Monday of each month



ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V Schlosser, M D, Charity Hospital of Louisiana, New Orleans 18 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O Jones M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday, 7 30 P M

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary* Charles N Davidson, M D, 101 West Read St, Baltimore 1

Michigan

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, E R Witwer, M D Harper Hospital, Detroit 1 Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R B MacDuff, M D, 220 Genesee Bank Building Flint 3

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C N Borman M D 802 Medical Arts Bldg, Minneapolis 2 Regular meetings in the Spring and Fall

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary* John W Walker, M D 306 E 12th St., Kansas City, Mo Meetings last Friday of each month

ST LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Edwin C. Ernst M D 100 Beaumont Medical Bldg Meets on fourth Wednesday of each month, October to May

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, O A Neely, M D 924 Sharp Building, Lincoln Meetings third Wednesday of each month at 6 P M in either Omaha or Lincoln

New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene M D Massachusetts Memorial Hospitals Boston Mass Meets monthly on third Friday at Boston Medical Library

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary-Treasurer*, Albert C Johnston M D Elliot Community Hospital Keene Meetings quarterly in Concord

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary* W H Seward, M D Orange Memorial Hospital

Orange Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J Francis M D, East Rockaway L I

BROOKLYN ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Abraham H Levy M D, 1354 Carroll St., Bklyn 13 Meets fourth Tuesday of every month October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer* Mario C Gian, M D, 610 Niagara St Buffalo 1 Meetings second Monday evening each month, October to May, inclusive.

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary-Treasurer*, Dwight V Needham M D 603 E Genesee St, Syracuse 10 Meetings in January, May and October

LONG ISLAND RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M D, 1430 48th St, Brooklyn 19 Meetings fourth Thursday evening each month at Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY *Secretary* Wm Snow, M D 941 Park Ave New York 28

ROCHESTER ROENTGEN RAY SOCIETY *Secretary*, Murray P George, M D, 260 Crittenden Blvd, Rochester 7 Meets at Strong Memorial Hospital third Monday, September through May

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary-Treasurer* James E Hemphill, M D, Professional Bldg Charlotte 2 Meets in May and October

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman M D 1338 Second St N Fargo

Ohio

OHIO RADIOLOGICAL SOCIETY *Secretary*, Henry Snow, M D 1061 Reibold Bldg Dayton 2 Next meeting at annual meeting of the Ohio State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary* Hugh A Baldwin, M D, 347 E State St Columbus

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer* George L Sackett M D 10515 Carnegie Ave. Cleveland 6 Meetings at 6 30 P M on fourth Monday October to April inclusive

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists) *Secretary-Treasurer* Samuel Brown M D 707 Race St, Cincinnati 2 Meets third Tuesday of each month

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer* Peter M Russo M D 230 Osler Building Oklahoma City Meetings three times a year

ROENTGEN DIAGNOSIS

THE CHEST

Discussion on the Stethoscope Versus X-Rays. John Donnelly South Med & Surg 108 248-249, August 1946

In certain diseases of the chest such as bronchitis, dry pleurisy, bronchiectasis, and heart disease, the stethoscope is a superior diagnostic instrument, but in the vast majority of chest conditions the x-ray examination is more informative. The author believes that most of the errors in radiologic diagnosis of chest diseases are due to inadequate use of available facilities and dependence on a single film. He urges more use of roentgen studies of the chest in the early years of medical training and believes they would contribute inestimably to a better understanding of the anatomy and physiology of the heart and lungs. He advocates the taking of a careful history, study of physical signs, and then study of the chest roentgenogram, with interpretation of the findings in the light of previous knowledge of the individual patient. In the diagnosis and treatment of chest conditions, the history is of supreme importance and the radiological findings next, while the stethoscopic findings are frequently only an aid in correct interpretation of the shadows seen on the film.

BERNARD S KALAYJIAN M D

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L W PAUL, M D

Bronchography in Tuberculosis A Clinical Study L Bryce Boyer Am Rev Tuberc 54 111-121 August 1946

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neither complication. The opinion is favored that the development of bronchiectasis in these patients was the result of the fibrous pulmonary changes superimposed upon alterations of the bronchi caused by infection.

In no case was a harmful effect produced on the tuberculous disease by bronchography. It is felt, however, that the procedure is not worth while as a routine in pulmonary tuberculosis because (1) it is well known from autopsy findings that fibroid tuberculosis is associated with bronchiectasis, (2) the contrast medium remains in the parenchyma and obscures succeeding roentgenographic changes, (3) rarely reactions occur. The primary use of the method lies in determining the source of a positive sputum when ordinary roentgenographic methods fail.

L W PAUL, M D

Interlobar Empyema. Joseph Levitin Am J Roentgenol 56 156-162, August 1946

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The causes of interlobar empyema are pneumonia, metastatic blood-borne or lymph-borne infection, direct trauma, lung abscess, and primary infection.

Treatment consists of surgical drainage of the interlobar empyema. Complete spontaneous evacuation of the encapsulated empyema is unusual.

H H WRIGHT, M D

Roentgenological Manifestations of Primary Pulmonary Coccidioidomycosis Max Rakofsky and Thomas W Knickerbocker Am J Roentgenol 56 141-155, August 1946

The roentgenologic features of primary coccidioidomycosis as seen in a study of 60 cases are presented.

Clinically primary coccidioidomycosis is manifest as an upper respiratory or mild bronchopneumonic illness with cough, chest pain, fever, erythema nodosum, and positive pulmonary roentgen findings. Most patients make a complete recovery after a period of several weeks. In some cases a secondary stage follows, characterized by severe skin and bone lesions, in addition to the pulmonary lesion, with a mortality of about 50 per cent. The secondary form follows the primary form only as an endogenous reinfection.

Positive roentgen findings of pulmonary abnormality were found in 85 per cent of the 60 cases studied. These findings were grouped as follows:

1	Nodular lesion, single or multiple	22%
2	Peribronchial infiltration	22 5%
3	Confluent consolidations	20%
4	Hilar lymphadenopathy	24 5%
5	Pleural involvement	5%
6	Cavity formation	5%
7	Bilateral nodular (local) dissemination	20%

The last named group including 12 cases represented a rather severe and extensive form of pulmonary involvement as compared with the others. The roent-

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Roentgenological Manifestations of Primary Pulmonary Coccidioidomycosis. Max Rakofsky and Thomas W. Knickerbocker. Am J Roentgenol 56 141-155 August 1946

The roentgenologic features of primary coccidioidomycosis as seen in a study of 60 cases are presented.

Clinically, primary coccidioidomycosis is manifest as an upper respiratory or mild bronchopneumonic illness with cough, chest pain, fever, erythema nodosum and positive pulmonary roentgen findings. Most patients make a complete recovery after a period of several weeks. In some cases a secondary stage follows, characterized by severe skin and bone lesions, in addition to the pulmonary lesion, with a mortality of about 50 per cent. The secondary form follows the primary form only as an endogenous reinfection.

Positive roentgen findings of pulmonary abnormality were found in 85 per cent of the 60 cases studied. These findings were grouped as follows:

1	Nodular lesion, single or multiple	22%
2	Peribronchial infiltration	22 5%
3	Confluent consolidations	20%
4	Hilar lymphadenopathy	24 5%
5	Pleural involvement	5%
6	Cavity formation	5%
7	Bilateral nodular (local) dissemination	20%

The last named group including 12 cases, represented a rather severe and extensive form of pulmonary involvement as compared with the others. The roent-

gen examination showed a widespread distribution of nodular lesions throughout both lungs individual nodules varying in size from 5 mm to 2.5 cm in diameter. This form of primary involvement may show gradual clearing or may progress to the granulomatous stage. Five case histories illustrating this severe form of primary coccidioidomycosis are presented. Two cases came to autopsy and the pathological findings are presented. One was an example of a generalized fulminating miliary coccidioidomycosis superimposed upon the bilateral, multiple nodular primary form. The other case showed a combination of active tuberculosis and coccidioidomycosis.

H. H. WRIGHT, M. D.

Pulmonary Actinomycosis Due to Actinomyces Asteroides Frederick W. Shaw, Rebecca A. Holt, and Edward S. Ray. *Virginia M. Monthly* 73: 362-368, August 1946.

A 34-year old white woman had a hacking productive cough associated with slight hemoptysis and left chest pain. A chest film showed minimal infiltrative lesions in both infraclavicular areas with a small amount of fluid at the left base, and a diagnosis of pulmonary tuberculosis was made. The patient was acutely ill with a white cell count of 28,000 (77 per cent polymorphonuclears). Shortly after admission to a tuberculosis sanitarium, Actinomyces was isolated from the pleural fluid but no tubercle bacilli were found either in the fluid or the sputum. Two months after admission an abscess developed in the right buttock and from this also Actinomyces was isolated. The patient was then transferred to the Medical College of Virginia Hospital from which this report comes. By this time respiratory distress had developed along with moderate cyanosis. A moderate leukocytosis persisted. A diagnostic aspiration showed the pleural fluid originally serous to have become frankly purulent, and surgical drainage was instituted. Shortly after this penicillin was given and Actinomyces disappeared from the drainage which gradually ceased. A left breast abscess also required drainage but it is not stated whether or not the organism was isolated from the abscess. A persistent fever yielded to sulfadiazine and the patient was discharged and eventually returned to work about eight months after admission. Some six months later it was necessary to excise a sinus tract from the right buttock because of a persistent serosanguineous discharge. The wound healed cleanly. A few months after this a left empyema necessitatis ruptured spontaneously from the drainage of which Actinomyces was isolated. Penicillin was given and after a few weeks the empyema space was obliterated. Subsequently cholecystectomy was done and the gallbladder was found to contain stones and to be the seat of an inflammatory process. Following operation penicillin was given in large dosage in the belief that this was indicated for the 'cure' of actinomycosis though no evidence is here presented that the infection was due to this cause. Two years and six months after her first hospital admission the patient was asymptomatic and without evidence of disease. A chest film revealed a thickened pleura on the left with no apparent residual empyema.

The authors believe that this case with a recurrence after a period of remission during which the infection must have remained dormant in the pleural cavity suggests the necessity of a follow up period of several

years before the final results of the different therapeutic measures can be evaluated.

A full discussion of the bacteriological and cultural identification of the Actinomycetes and their classification is given.

J. E. WHITELEATHER, M. D.

Pulmonary Filariasis Harold Rifkin and Theodore P. Eberhard. *Ann. Int. Med.* 25: 324-329, August 1946.

The authors cite a recent editorial in the *Naval Medical Bulletin* (54: 181, 1945) in which the statement is made that there is in filariasis a "pulmonic phase manifested by a prevalent morning cough, conspicuous in natives of endemic areas, which leads to a suspicion of widespread tuberculosis." In the literature available to them they could find no record of proved pulmonary filariasis or filarial pneumonia. They had, however, occasion to examine a native of a South Pacific island whose clinical picture suggested this possibility.

The patient was a 39-year old civilian laborer, who complained of a hacking cough, blood stained sputum, and night sweats of two years' duration, as well as fatigue and malaise. Dullness diminished breath sounds, and moist râles were observed in the right half of the chest, anteriorly and posteriorly and below the angle of the scapula on the left side posteriorly. There was no lymphadenopathy and no evidence of elephantiasis of the upper or lower extremities.

A chest film showed a soft, mottled diffuse shadow of increased density fanning out from the left hilum into the lower lobe and covering the lung field from the border of the eighth rib downward. The shadow became less dense below and laterally, leaving the lung margins almost clear. A shadow of the same character but occupying an irregular area about 5 cm in diameter, was present in the mid zone of the right second anterior interspace. Six weeks later all of the shadows had regressed. The fluffy shadows of parenchymal infiltration had cleared leaving in the left lower and right upper lobes fan shaped zones of hard linear densities extending from the hilum.

Microfilariae (*Wuchereria bancrofti*) associated with many eosinophils were found in sputum concentrates, but no acid fast bacilli, yeasts, fungi or molds. Peripheral blood examination revealed a heavy microfilarial infestation and a skin test gave a positive reaction to a titer of 1:8,000 and 1:16,000. These findings are believed to suggest an acute filarial reaction involving the bronchial lymphatics. It is further suggested that edema and eosinophilic infiltration of these lymphatics were responsible for the transitory pulmonary infiltrations demonstrated roentgenographically.

The presence of the microfilariae in the sputum can be explained on two bases: first, rupture of the alveolar capillaries with an outpouring of the organisms circulating in the blood stream into the alveoli; second, involvement of the larger bronchioles and bronchi in a generalized filarial infection producing increased intraluminal tension with resultant filarial bronchoreflex.

STEPHEN N. TAGER, M. D.

Organizing Hemothorax—A Clinical Entity Robert Tunkham Crowley. *Am. J. M. Sc.* 212: 241-250, August 1946.

Organizing hemothorax may be defined as a condition usually produced by trauma to the thoracic cavity

or its contents, in which there exists within the pleural space a clot formed by the resultant hemorrhage, which subsequently undergoes progressive organization by the ingrowth of fibrous connective tissue from the adjacent pleural structures. Its significance has only recently been recognized, and the methods of diagnosis and treatment are largely developments of World War II.

The signs and symptoms of organizing hemothorax can be classified into 2 groups (1) constitutional, resulting from body response to reaction within the pleura, and (2) localizing. The constitutional manifestations are indistinguishable from those incident to pleural reaction from liquid blood or infection in the pleura and are in general those incident to any inflammatory reaction. The localizing signs and symptoms are of considerably more significance. These arise in the main from pressure by the clot upon the lung and adjacent pleural structures, producing a lowered vital capacity, and vary in severity with the amount of involvement.

Clinical signs are essentially those of fluid in the chest, and roentgenography and aspiration are essential for differentiation. Postero-anterior and lateral films usually show a diffuse haziness over the whole or part of the affected side of the chest with collapse of the lung of varying degrees. Air is commonly but not invariably present. The area of pulmonary collapse is frequently seen in the most dependent portion of the pleural cavity and affects the lower lobe. Early in the course of the hemothorax there may be, if sufficient fluid and air are present widening of the intercostal spaces on the side of the lesion with a perceptible shift of the mediastinum to the opposite side. The fluid level depending upon whether or not air is present may or may not be sharply defined. As the process of organization proceeds, the fluid level tends to become diffuse and hazy, the interspace of the thoracic cage narrowed, and the mediastinum shifted back toward the affected side. The diaphragm on the involved side in the later stages, is elevated above its normal position. Fluoroscopy will confirm a restriction of respiratory movement in the chest wall and particularly of the diaphragm. Lateral roentgenograms are of particular importance in determining the exact location and extent of the lesion. Serial x ray studies rarely more than a week apart are essential in following the progress of the organizing hemothorax. Of particular diagnostic significance are failure to recover fluid blood upon repeated aspiration, or recovery of only small amounts containing macroscopic clots, and the presence of pyogenic organisms in the pleural aspirate.

The treatment of organizing hemothorax may be conservative or radical, the choice depending almost entirely upon the amount of anatomic and functional involvement. The technic of operation and special features of operative treatment are discussed. Atelectasis and empyema are the most frequent postoperative complications and must be guarded against.

A typical case of organizing hemothorax is presented, together with roentgenograms.

Spontaneous Pneumothorax in the Newborn Ed-
win P. Scott and C. C. Rotondo. *Am J Dis Child*
72: 207-210. August 1946.

Although relatively rare spontaneous pneumothorax of the newborn is probably more common than generally supposed. In this paper the authors have reported

the sixth case on record of this condition in an infant delivered by cesarean section. The study is especially interesting in that trauma during delivery is generally believed to play a major role in the etiology.

Fever and dehydration developed on the fifth day of life. The infant became cyanotic, lethargic, and flaccid, and had a mild convulsion. Treatment consisted in the administration of oxygen in addition to the usual measures to combat dehydration and convulsions. The following day the temperature was normal but respirations were shallow. A roentgenogram showed a right pneumothorax. Five days later, this had completely cleared.

The authors believe that treatment in these cases should be conservative, aspiration being reserved for the more severe forms. The importance of roentgenography is stressed, as clinical signs and symptoms are not always prominent in the newborn.

M. WENDELL DIETZ, M.D.

Mucocellular Papillary Adenocarcinoma of the Lung and Lobectomy Kermut E. Osserman and Harold Neuhoef. *J Thoracic Surg* 15: 272-278, August 1946.

Mucocellular papillary adenocarcinoma of the lung is uncommon. A review of the literature reveals 19 cases, all of which were diagnosed at autopsy. This type of tumor has been described by various authors under many different names, as alveolar cell tumor, primary cancer of the lung, adenoma, papillary gelatinous adenocarcinoma, alveolar epithelial cancer, multicentric alveolar carcinoma, adenomatosis, etc. Neuburger and Geever in an excellent review (*Arch Path* 33: 551, 1942) classified all these types as alveolar-cell tumor of the lung, whether or not they are mucus-producing.

The tumor arises either as a multicentric nodular neoplasm or as a diffuse infiltrating growth, combinations of both types are occasionally observed. The diffuse form is characterized by involvement of a lobe or an entire lung on one or both sides. Metastases are not a prominent feature.

The microscopic picture of the nodular and diffuse forms is identical and Malassez' description in 1876 adequately describes the histology. The tumor stroma is made up of the alveolar walls. The latter are lined by cuboid or columnar neoplastic cells in one or more layers. Papillary protrusions of such cells are frequent. Mucinous secretion is present.

A study of the clinical records revealed no distinctive symptoms. In some cases a diagnosis of pulmonary tuberculosis was made, in others, the course was rapid and the impression was one of lobar or bronchial pneumonia. The majority of the patients did not survive more than one year. Occasional symptoms are cough, hemoptysis, cyanosis, and pain in the chest with evidence of pleural effusion.

Three cases are presented. One case, reported in detail, was unusual in that symptoms were of three years' duration before the patient came to the authors' attention and that, two years after lobectomy, there had been no evidence of recurrence. Roentgenograms showed a solid tumor occupying two-thirds of the left lower lobe. Two other cases recognized postmortem are mentioned briefly. HAROLD O. PETERSON, M.D.

Scleredema: A Systemic Disease Bert L. Vallee. *New England J Med* 235: 207-213, Aug 15 1946.

Four cases of scleredema are presented bringing the total to 103. This disease is characterized by firm non-

putting edema affecting usually the face, neck, scalp, conjunctivae, and thorax, occasionally the arms, and more rarely the legs, sparing the hands and feet. The condition is not primarily of radiologic interest, a ray examination of the chest has only rarely been carried out and usually shows no abnormality. One of the author's patients, however, had a right pleural effusion when first seen, and later a loculated effusion along the right border of the heart. Both these effusions regressed as the process cleared. Another of the patients had massive bilateral effusions during the initial phase of the disease. These are thought to be the first cases in which pleural and pericardial effusions have been reported as part of the scleredema syndrome. Such intrathoracic effusions are believed to be intrinsic features of the disease and indicate, as do the reported hydrarthroses, that scleredema is not limited to the skin and subcutaneous tissue and may, in fact, present a puzzling picture to the internist.

Dextrocardia and Bronchiectasis. A Review of the Literature and a Report of Two Cases. A. H. Russakoff and Harvey W. Katz. *New England J Med* 235 253-255, Aug 22, 1946.

With the present report of two examples, the total number of cases of dextrocardia complicated by bronchiectasis is brought to 50. The combination of sinus disease, bronchiectasis, and visceral transposition has been known as "Kartagener's triad." The dextrocardia is offered as proof of the congenital origin of bronchiectasis.

The incidence of bronchiectasis in the general population is estimated at less than 0.5 per cent, while the incidence of bronchiectasis in dextrocardia is about 16 per cent. With mass chest radiography cases of dextrocardia are bound to be discovered and the author believes that a diligent investigation of these patients will show bronchiectasis and other abnormalities.

JOHN B. MCANENY, M.D.

Demonstration of Ventricular Septal Defect by Means of Right Heart Catheterization. Eleanor deF. Baldwin, Lucille V. Moore and Robert P. Noble with Technical Assistance of Michaela Patterson and Doris M. Harnsberger. *Am Heart J* 32 152-162 August 1946.

The recently developed technic for catheterization of the right heart has been found especially useful for the detection of interventricular septal defects. Following the introduction of the catheter under fluoroscopic control, samples of blood may be withdrawn from various known areas. A comparison of the respiratory gas content of the various blood samples with one another and with that of arterial blood will indicate whether or not an arteriovenous shunt is present. Further information on the hemodynamics may be obtained by connecting the intracardiac catheter to a recording type of manometer and analyzing the resultant pressure tracings. Finally, by direct observation of the movements of the catheter within the right heart, useful impressions as to the size, shape, and location of the chambers of the heart may be acquired, which supplement the information obtained from the routine x-ray and fluoroscopic studies.

The demonstration of arterialization of the right ventricular blood is proof of an interventricular arteriovenous shunt. A variation of oxygen content of more

than 2 volumes per cent between ventricular and auricular samples may be considered a significant difference, denoting an abnormal communication.

The authors report their observations on 2 cases of congestive circulatory failure of obscure etiology, in which arterialization of the right ventricular blood, demonstrable by cardiac catheterization, led to a diagnosis of ventricular septal defect.

The detection of an arteriovenous shunt by this method depends upon the tip of the catheter being bathed by a sufficiently large admixture of arterial blood during the collection of the blood sample to produce a significant auricular-ventricular oxygen difference. Small shunts therefore may be missed.

The method of cardiac catheterization is not described in detail beyond the statement that the radiopaque catheter is passed through the median basilic vein into the thorax under fluoroscopic vision, and that the tip is manipulated into the desired position but reference is made to the description of Courmand *et al* (*J Clin Investigation* 24 106, 1945). [For a recent account see Sosman. *Radiology* 48 441 May 1947 Ed.]

HENRY K. TAYLOR, M.D.

Hernia Pericardii. A. Lincoln Brown and Sydney F. Thomas. *Am J Surg* 72 262-266 August 1946.

A case of hernia of the pericardial sac is presented which is believed to be the first lesion of this type proved by operation. The literature is reviewed with mention of 40 cases collected by Cushing in 1937, all found post mortem. The condition has been ascribed to (1) weakness of the wall of the pericardial sac, most likely to occur at points of entrance of vessels or nerves, (2) external traction due to some localized adhesive process which tents the sac wall. No favorite sites are described.

The case here recorded in a young male, was an incidental finding on routine chest roentgenography. A smooth rounded mass was seen in the right cardiohepatic angle. At operation a thin walled sac 7.5 x 10 cm. was discovered in the right lateral wall of the pericardium. Pericardial fluid was seen to swish back and forth from the parent organ on systole. The sac was easily extirpated and the wall was found to be fibrous tissue lined with polyhedral cells having large pale nuclei.

Diagnostic roentgenologic aids were (1) kymography showing pulsations even greater than those of the myocardium, (2) the Trendelenburg position which completely obliterated the mass, (3) diagnostic pneumothorax which facilitated the outlining of the mass cooperatively.

EDWARD M. DEYOUNG, M.D.

THE DIGESTIVE SYSTEM

Further Experiences in the Surgical Treatment of Congenital Atresia of the Esophagus with Tracheo-esophageal Fistula. Conrad R. Lam. *Surgery* 20 174-179 August 1946.

The author has previously reported 4 cases of atresia of the esophagus and tracheo-esophageal fistula treated surgically (*J Pediat* 27 456 1945; *Abst In Radiology* 47 307 1946). One child died after an unsuccessful operation. In one of the others an antethoracic esophagus has now been completed and at the age of two and a half years the child is eating without difficulty. A summary of this case is included in the present paper though the procedure employed is now considered inferior to direct anastomosis. The other

two infants, in whom direct anastomosis was done, are alive and well at sixteen and eighteen months. All 4 cases were of Vogt's type 3B, having an upper blind pouch and a fistula between the lower segment and the trachea.

Three new cases also of type 3B, are here reported in all of which direct anastomosis was attempted. In the first case, the diagnosis was established on the first day of life, and on the next day anastomosis was accomplished. On the sixth day there was leakage of formula from the drainage site in the operative wound and on the tenth day a gastrostomy was established. Within one month drainage ceased, feeding by mouth was resumed, and the gastrostomy was allowed to close. This child was in a normal state of nutrition at the age of ten months. The other 2 cases are of interest surgically because of technical failures. In one of these the patient died. In the other the attempt at direct anastomosis had to be abandoned in favor of a multiple-stage procedure. The final plastic procedures in this case had not been completed at the time of the report.

J E WHITELEATHER, M D

Antral Gastritis and Spasm. Their Clinical and Surgical Significance. James W R Rennie. *Ann Surg* 124 402-409, August 1946

In this paper the author emphasizes the difficulty and the importance of an accurate diagnosis of antral gastric disease. Antral spasm is best estimated by the radiologist by fluoroscopy and by serial films, which show constant contraction without derangement of the normal mucosal folds of the antrum. If the spasm is marked or persistent, the films may show elongation and narrowing of the antrum, a picture very similar to that of some cases of antral gastritis.

A fluoroscopic diagnosis of antral gastritis can be made in the presence of a deranged antral systole coupled with the finding of stiff unnatural folds which cannot be obliterated during pressure. The films characteristically show persistent spasm with elongation and a funnel shaped narrowing of the antrum. Sometimes there is indentation of the duodenal cap. This is believed to be due to squeezing of the stiffened mucosa through the pyloric ring (Kirklin's sign).

The symptomatology of antral spasm and gastritis shows an amazing similarity. The findings are a peculiar combination of those seen with gastric ulcer, gastric carcinoma, and gallbladder disease. Acidity tends to be normal or high in cases of gastritis, but the free acid is low or absent in antral spasm.

Surgically, the primary concern is with those cases showing an antral defect simulating carcinoma. Attention to mucosal relief patterns and gastroscopic examination will provide the diagnosis in many cases. If a definite diagnosis cannot be made after a short period of observation with repeated examinations, exploration is indicated.

Four typical cases are presented to illustrate the similarities of spasm, gastritis and carcinoma.

M WENDELL DIETZ, M D

Regional Ileitis Involving the Ileum, Cecum, Ascending Colon, and Transverse Colon. I I Cash, L S Pilcher, A E Rappoport, and W A Barker. *Ann Int Med* 25 351-362, August 1946

So-called "regional ileitis" was originally believed to involve principally the terminal ileum in a chronic granulomatous process. Later it was observed that

other segments of bowel could be involved by a similar process, particularly the upper part of the ileum, the lower jejunum and the proximal portion of the colon. Clinical features are the presence of anemia, diarrhea, abdominal pain, low grade fever and a mass in the right lower quadrant. No definite etiological factors have been determined, although acute bacillary dysentery has been suspected of having some etiological relationship.

The clinical diagnosis of granulomatous ileocolitis is based primarily on the roentgen findings. In the very early stage nothing more than irritability, localized spasm, and hypermotility of the involved segment (usually the terminal ileum) may be seen. As the disease progresses this portion of the intestine becomes smooth, thickened and contracted, with narrowing of the lumen producing the typical "string sign." The normal mucosal pattern is obliterated and ulceration of the mucosa of the involved segment may be demonstrated on spot pressure films. The margins of the diseased portion are slightly fuzzy and irregular as a result of ulceration. In the later stages, it is not unusual to observe marked constriction, sufficient to cause obstruction, associated with dilatation of the intestine proximal to the lesion accompanied by the development of fistula. Roentgenologically, the involvement is often sharply demarcated. Though many believe a barium meal study is of greater value, no case should be subjected to operation without a barium enema.

From the roentgenologic standpoint, the differential diagnosis usually lies between regional ileitis and ileocecal tuberculosis. Primary enterocolic tuberculosis is relative rare. In the absence of pulmonary tuberculosis and with the inability to recover acid-fast organisms from the stool, intestinal tuberculosis can usually be excluded, although an occasional case cannot be distinguished from regional ileitis, except at operation. Neoplasm, appendiceal abscess and Meckel's diverticulitis should be considered, but the history and the roentgen-ray findings are usually sufficient to exclude these.

Clinically, the early symptoms closely resemble those of appendicitis, but in the later stages the resemblance is less striking. Amebic colitis, chronic bacillary dysentery, and ulcerative colitis must also be considered in the differential diagnosis. Amebic colitis usually will show typical small, discrete, punched-out ulcers in the lower bowel with pus and blood in the stool and the amebae may often be recovered from a warm stool specimen. Ulcerative colitis can usually be diagnosed by roentgen ray and the sigmoidoscopic examination. The diagnosis of chronic bacillary dysentery depends on the isolation of the specific organism from the stool and rising serial serum agglutination titers.

The general consensus of opinion at present considers surgery the only satisfactory treatment of granulomatous ileocolitis. All of the diseased bowel and the diseased mesenteric nodes must be removed if a satisfactory result is to be obtained.

A case in a 22 year-old soldier is recorded. This is of interest primarily because of the widespread involvement of the intestinal tract, but also because having been closely followed in Army hospitals for over a year, it illustrates graphically the classical picture of the onset and progress of the disease, with all its diagnostic and therapeutic trials and pitfalls.

The original x-ray studies, made elsewhere, would seem retrospectively to have warranted a diagnosis of

pitting edema, affecting usually the face, neck, scalp, conjunctivae, and thorax, occasionally the arms, and more rarely the legs sparing the hands and feet. The condition is not primarily of radiologic interest, x ray examination of the chest has only rarely been carried out and usually shows no abnormality. One of the author's patients, however, had a right pleural effusion when first seen, and later a loculated effusion along the right border of the heart. Both these effusions regressed as the process cleared. Another of the patients had massive bilateral effusions during the initial phase of the disease. These are thought to be the first cases in which pleural and pericardial effusions have been reported as part of the scleredema syndrome. Such intrathoracic effusions are believed to be intrinsic features of the disease and indicate, as do the reported hydrarthroses, that scleredema is not limited to the skin and subcutaneous tissue and may in fact, present a puzzling picture to the internist.

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Regional Ileitis Involving the Ileum, Cecum, Ascending Colon, and Transverse Colon. I I Cash, L S Pilcher, A E Rappoport and W A Barker. *Ann Int Med* 25: 351-362, August 1946.

So-called regional ileitis was originally believed to involve principally the terminal ileum in a chronic granulomatous process. Later it was observed that

other segments of bowel could be involved by a similar process, particularly the upper part of the ileum, the lower jejunum, and the proximal portion of the colon. Clinical features are the presence of anemia, diarrhea, abdominal pain, low-grade fever, and a mass in the right lower quadrant. No definite etiological factors have been determined, although acute bacillary dysentery has been suspected of having some etiological relationship.

The clinical diagnosis of granulomatous ileocolitis is based primarily on the roentgen findings. In the very early stage nothing more than irritability, localized spasm, and hypermotility of the involved segment (usually the terminal ileum) may be seen. As the disease progresses this portion of the intestine becomes smooth, thickened and contracted with narrowing of the lumen producing the typical "string sign." The normal mucosal pattern is obliterated, and ulceration of the mucosa of the involved segment may be demonstrated on spot pressure films. The margins of the diseased portion are slightly fuzzy and irregular as a result of ulceration. In the later stages, it is not unusual to observe marked constriction, sufficient to cause obstruction, associated with dilatation of the intestine proximal to the lesion, accompanied by the development of fistula. Roentgenologically, the involvement is often sharply demarcated. Though many believe a barium meal study is of greater value, no case should be subjected to operation without a barium enema.

From the roentgenologic standpoint the differential diagnosis usually lies between regional ileitis and ileocecal tuberculosis. Primary enterocolic tuberculosis is relative rare. In the absence of pulmonary tuberculosis and with the inability to recover acid fast organisms from the stool, intestinal tuberculosis can usually be excluded, although an occasional case cannot be distinguished from regional ileitis, except at operation. Neoplasm, appendiceal abscess and Meckel's diverticulitis should be considered, but the history and the roentgen-ray findings are usually sufficient to exclude these.

Clinically, the early symptoms closely resemble those of appendicitis, but in the later stages the resemblance is less striking. Amebic colitis, chronic bacillary dysentery, and ulcerative colitis must also be considered in the differential diagnosis. Amebic colitis usually will show typical small, discrete punched-out ulcers in the lower bowel with pus and blood in the stool, and the amebae may often be recovered from a warm stool specimen. Ulcerative colitis can usually be diagnosed by roentgen ray and the sigmoidoscopic examination. The diagnosis of chronic bacillary dysentery depends on the isolation of the specific organism from the stool and rising serial serum agglutination titers.

The general consensus of opinion at present considers surgery the only satisfactory treatment of granulomatous ileocolitis. All of the diseased bowel and the diseased mesenteric nodes must be removed if a satisfactory result is to be obtained.

A case in a 22 year-old soldier is recorded. This is of interest primarily because of the widespread involvement of the intestinal tract but also because, having been closely followed in Army hospitals for over a year, it illustrates graphically the classical picture of the onset and progress of the disease, with all its diagnostic and therapeutic trials and pitfalls.

The original x-ray studies, made elsewhere, would seem retrospectively to have warranted a diagnosis of

ileocolitis involving the terminal ileum cecum, and perhaps other portions of the colon, but though the possibility was mentioned a definite diagnosis was not made. When the authors saw the patient, about a month later, the most significant roentgen finding was a very smooth tubular appearance of the distal 8 cm. of the ileum which was somewhat narrowed and showed loss of the normal mucosal pattern. The five hour film of the gastro-intestinal series showed similar changes. The fluoroscopic examination at the same time demonstrated irritability of the terminal ileum and cecum. On the basis of these observations a diagnosis of terminal ileitis with involvement of the cecum and ascending colon was established.

In spite of wide radical resection, extending 12 inches above the obviously diseased part of the ileum (confirmed by examination of the specimen) and several inches beyond the involved half of the transverse colon, symptoms reappeared within a few months and an exploratory operation was undertaken. This confirmed the roentgen diagnosis of recurrence in the terminal ileum and colon. Because of the extent of the process further resection was not undertaken. The patient was treated by rest, ultraviolet radiation and cod liver oil with good immediate results, but within six months there were further symptoms, and roentgen studies in a civilian hospital showed evidence of progression of the disease to involve the remaining portion of the ileum.

STEPHEN N. TAGER, M.D.

Spontaneous Pneumoperitoneum Without Peritonitis and Without Demonstrable Cause J. M. Mason, E. M. Mason and K. F. Kesmodel. *South M. J.* 39: 620-624, August 1946.

Spontaneous pneumoperitoneum is usually due to a ruptured viscus, the most frequent cause being perforation of the stomach or duodenum by a benign or malignant ulcer. Other causes are rupture of the appendix or of the small bowel from ulcer and rupture of the colon or rectum as a result of carcinoma. In such cases there is usually an associated peritonitis calling for prompt operation.

A review of the literature revealed only a few cases of proved spontaneous pneumothorax in which no peritonitis developed and for which no cause could be found. The entrance of air *via* the fallopian tubes has been suggested but this seems unlikely considering the pressure required in doing a Rubin test. European authors speak of a 'pneumatosis cystoides intestinalis' in which subserous blebs on the intestine presumably due to a parasite may rupture with the release of air.

The authors report a case of massive spontaneous pneumoperitoneum studied by them without discovery of the cause. Follow up films showed the air to have been absorbed. In studying these cases the first film should be a lateral view (horizontal rays) with the patient supine. After this an anteroposterior or postero-anterior view can be taken. Frequently a film with the patient erect is unnecessary. FRANCIS F. HART, M.D.

THE MUSCULOSKELETAL SYSTEM

Still's Disease (Atrophic Arthritis, Atrophic Rheumatoid Arthritis or Infectious Rheumatoid Arthritis) William F. Burdick. *South M. J.* 39: 626-630, August 1946.

The author discusses the incidence, etiology, symptomatology and physical signs of atrophic rheumatoid

arthritis in children. The hereditary background and body habitus of the individual are emphasized. Several etiologic theories are mentioned but the author concludes that no causes are known at present and that the disease is probably of infectious origin.

Pain is present early and often precedes swelling of the joints. The child may become fretful and irritable, fever is present in varying degrees, the skin is pale and there may be an erythematous or pigmented eruption. Subcutaneous fibrous nodules are found in 20 per cent of the cases. Generalized lymphadenopathy and splenomegaly are usually seen in young children.

The x-ray picture is characteristic. At first only the soft tissue swelling is seen. Later rarefaction of the bone is evident especially in the epiphyses. As the disease progresses the gradual destruction of cartilage and loss of bone substance are striking.

Treatment involves general and psychological care, and orthopedic measures from an early date to prevent crippling and, if ankylosis becomes inevitable, to insure an optimum physiological position.

Two cases are reported. PHILIP W. DORSEY, M.D.

Pathogenesis of Charcot's Joint. Percy J. Delano. *Am. J. Roentgenol.* 56: 189-200, August 1946.

Using an extensive review of the pertinent literature as a basis, the author discusses the pathogenesis of Charcot's joint. Charcot and others have believed in the existence of special trophic nerves; damage to which permitted development of the so-called neurotrophic joint. Volkmann, a contemporary of Charcot, and others since his time contend that the changes seen in neurotrophic arthropathy are brought about by repeated subclinical traumata occurring in an insensitive joint and deny the existence of trophic nerves. The author adheres to the latter belief.

A case is recorded in which the patient has been paralyzed from the waist down for fifteen years following fracture of the first lumbar vertebra in an automobile accident. Roentgen examination showed extensive irregular bony overgrowth and osteosclerosis consistent with a joint neuropathy. The trauma in this instance is ascribed to repeated turning of the patient on his right side for nursing care. Pathological changes occurring in neurotrophic joints are discussed in detail. A full bibliography is appended. H. H. WRIGHT, M.D.

Disseminated Reticuloendothelial Tumor of the Bone Marrow with Nodular Osteosclerosis. Frank Windholz. *Arch. Path.* 42: 206-213, August 1946.

A case of primary disseminated nodular reticuloendothelial tumor of the bone marrow with neoplastic growth of both the reticular and the endothelial components of this cellular system is presented. Circumscribed bone formation was present in areas involved by the tumor. The newly formed bone tissue was mainly contributed by metaplasia of the collagenous and reticular stroma of the tumor itself.

The patient, a 60-year-old woman, entered the hospital because of hypertensive disease (blood pressure 200/120) of about a year's duration accompanied by some weight loss. The heart was slightly enlarged, the liver and spleen were of normal size. No lymph nodes or masses were palpated. Excretory urography revealed no abnormalities of the urinary tract. Plain roentgenograms disclosed numerous rounded sclerotic densities of various sizes in the innominate bones, the

sacrum, the lumbar vertebrae, the ribs, and the calvarium. The fifth vertebra was entirely dense. The roentgen picture suggested osteoclastic tumor metastases or Hodgkin's disease with atypical skeletal distribution and biopsy revealed the findings described above. The patient's condition steadily declined and she died with signs of congestive heart failure eight months after admission. Permission for autopsy was refused.

Pyogenic Infection of the Spinal Epidural Space
Robert M Rankin and Paul G Flothow. West J Surg 54: 320-323, August 1946

Two hundred and seventeen cases of pyogenic infection of the spinal epidural space were collected from the literature up to 1941. Since then 8 additional cases have been recorded. The disease occurs in the wake of suppurative infection anywhere in the body and is seen at all ages. The bacteria invade the spinal canal by direct extension from a contiguous suppuration, such as a vertebral osteomyelitis, a decubitus, or cellulitis of the neck, or by metastasis *via* the blood or lymph channels. The condition practically never results from a leptomeningitis perforating the dura. The staphylococcus is usually the causative organism, and the infection is localized chiefly to the broad areas in the epidural space, in the mid-thoracic and the mid lumbar regions.

The infection may be extremely fulminating and cause death in a matter of hours or may be chronic, producing progressive paralysis over a period of months or years. Damage to the underlying spinal cord is profound. It is believed to be due to thrombosis of intraspinal vessels and obliteration of the intraspinal lymph spaces as a result of the contiguous inflammatory process.

The clinical picture follows a regular pattern—severe intractable pain in the vertebral axis followed by radicular pains in the distribution of the involved segment. In about half of the cases there is tenderness of the involved spines and there may be a localized swelling. A marked rigidity of the spine is present. Within a day or so symptoms of cord compression appear, with paralysis and loss of sensation below the lesion. The usual laboratory signs of infections are present. The spinal fluid shows increased protein, usually 100 to 300 mg, some pleocytosis, and abnormality of the gold curve. The Queckenstedt test almost invariably demonstrates a partial or complete subarachnoid block. In the chronic cases the symptomatology and findings are identical, but the course is less fulminating, with little or no febrile reaction.

If the physical signs make one suspicious of an epidural inflammatory mass in the lower lumbar region, lumbar puncture should not be done as a meningitis may result. In these cases cisternal puncture and myelography will confirm the diagnosis. Radiologic evidence of destruction of the vertebrae themselves is the exception rather than the rule. Once the diagnosis has been established, immediate laminectomy is imperative. The over all operative mortality is 33 per cent, of those who survive, 40 per cent have complete return of function.

The authors present a case in a woman of thirty one, following a vertebral osteomyelitis subsequent to a tooth infection. An unusual feature of the case was the fact that roentgenograms showed progressive destruction of the left lateral and transverse processes of

the 4th, 5th, and 6th cervical vertebrae. A hemilaminectomy was performed, and the laminae of the 3d to the 6th cervical vertebrae were found to be involved by a destructive inflammatory process. The posterolateral aspect of the dura was encased in a tough, fibrous, densely adherent layer of scar tissue, which also encased the 4th, 5th, 6th and 7th cervical nerves. There was no free pus. All the scar tissue was dissected off but the dura was not opened. Though treatment was delayed it was followed by complete functional recovery and practically complete healing of the partially destroyed vertebrae as demonstrated roentgenographically. BERNARD S KALAYJIAN, M D

Multiple Fractures in the Long Bones of Infants Suffering from Chronic Subdural Hematoma John Caffey. Am J Roentgenol 56: 163-173, August 1946

Six cases of chronic subdural hematoma in infants are presented in which 23 fractures and 4 contusions of the long bones were demonstrated. In none of the cases was there a history of injury to which the skeletal lesions could reasonably be attributed, and in none was there evidence of generalized or localized skeletal disease which would predispose to pathological fracture. Fractures of all of the large bones in the upper and lower extremities were included, but there were no fractures of the small bones of the hands or feet, and none of the cranium or flat bones of the pelvis and shoulder girdle. In none of the cases was there clinical or roentgen evidence of vitamin C deficiency or of other generalized disease. History of injury to the head was also lacking in all cases. Several of the fractures appeared many weeks or months after the first clinical manifestation of subdural hematoma. There was little evidence to indicate that convulsive seizures were responsible for the fractures. Their cause remains obscure.

The presence of unexplained fractures in the long bones of infants warrants investigation for subdural hematoma. Routine examination of the long bones in subdural hematoma is necessary for identification of fractures because many of them are clinically silent.

H H WRIGHT, M D

Displacement of Medial Epicondyle of Humerus into the Elbow Joint. Frederick M Smith. Ann Surg 124: 410-425 August 1946

Twenty one cases of separation of the medial epicondyle of the humerus are reported in this study of a common childhood injury. The paper deals with that type of separation in which there is complete avulsion of the epicondyle with its downward and lateral displacement and incarceration into the elbow joint. Each case was associated with a dislocation of both bones.

The condition is frequently missed even with adequate roentgenograms, either because the lesion is not watched for, or because the displaced epicondyle is mistaken for an ossification center of the trochlear epiphysis. In cases of doubt, films of the uninjured elbow in identical positions should be taken for comparison. If the patient is unable to extend the elbow fully two anteroposterior views are recommended—one with the lower humerus lying flat on the film and the other with the upper portion of the forearm lying flat on the film.

In 15 cases of the author's series, treatment of the medial epicondyle *per se*, after extraction from the

joint and after reduction of the elbow joint, consisted in fixation to the medial condylar ridge by means of a suture of heavy silk passed through a drill hole in the ridge. In 1 case, in a boy of seventeen fixation was by single stainless steel screw. In 5 cases the epicondyle was completely excised and the common tendon of origin of the flexor pronator group of muscles was re-sutured to the medial condyle. From the point of view of function, the author concludes that it makes little difference whether the epicondyle is replaced or removed. Actually, late follow up examinations show slight enlargement or irregularity of the replaced epicondyle, but this is seldom detected by the patient himself. After following his patients for more than three years the author can report that all showed excellent to perfect results, with a single exception, in which only a fair to good result was obtained.

The proximity of the ulnar nerve, in its groove on the posterior surface of the epicondyle, explains the frequency with which ulnar palsy is seen following this type of injury. All patients in the present series with this complication recovered complete function of the nerve. Treatment consisted in injection of the nerve sheath with saline solution and replacement to its normal location or transposition to the anterior surface of the medial condyle. M. WENDELL DIETZ, M.D.

Fractures of the Carpal Scaphoid Bone. An Analysis of Sixty-Six Cases. Moss M. Bannerman. Arch Surg 53 164-168 August 1946.

The correct treatment of fractures of the carpal scaphoid is adequate prolonged fixation. This treatment is often omitted because of failure of diagnosis. This in turn is usually due to the mildness of symptoms in the early stages. In the author's series of 66 cases 42 per cent were not diagnosed at the time of injury. 7 per cent of the patients failed to report the injury for several weeks while in the other 35 per cent the fracture was diagnosed as a sprain clinically and either no roentgen examination was made or the fracture line was missed.

In view of the large number of misses the author recommends the use of oblique views at 30- and 60 degree angles, in addition to the routine palmar and lateral projections. The clinical symptoms consist of persistent pain in the anatomic snuff box with weakness and increased pain after exertion. Swelling and moderate limitation of motion are less constant findings but their presence is sufficient to warrant detailed examination of the wrist.

Treatment consists in complete and prolonged immobilization and this may be employed even when long periods (up to ten months) have elapsed following the injury. The author prefers a skin-tight cast including the thumb and extending from the elbow to the distal palmar crease with the wrist in moderate dorsiflexion and slight radial deviation. In 85 per cent of his cases this led to healing without arthritic changes. All fractures incurred less than six months before instituting treatment healed satisfactorily. The presence of traumatic osteoporosis (Preiser's disease) did not prevent union. Operative intervention was not instituted until after at least two months' immobilization and was limited to 10 cases. Functional recovery was excellent in all cases seen and was surprisingly rapid. This is attributed in great part to the continuous use of the fingers in physical and occupational therapy during the immobilization period. LEWIS G. JACOBS, M.D.

Incipient Epiphyseolsthesis of the Hip. Its Diagnosis and Treatment. Samuel Klemberg. Am J Surg 72 190-201, August 1946.

Attention is directed to slipping of the capital epiphysis in adolescence as a cause of arthritis of the hip joint in the adult and the author advocates early fusion of the slipped epiphysis to the femoral neck to prevent the arthritic sequelae as well as to relieve the immediate symptoms. Incipient and acute cases respond best to this procedure. Moderate or severe slipping, with or without treatment, eventuates in a hip joint which is not nearly so satisfactory.

The roentgenologic diagnosis is made from antero-posterior and lateral films, both of which are mandatory. The capital epiphysis slips downward, backward and inward on the femoral neck. Normally it projects a little beyond the superior border of the neck forming a sort of "shoulder". This "shoulder" is reduced or obliterated in epiphyseolsthesis. The femoral head may also present a crescentic appearance rather than its normal hemispherical shape. In the lateral view the downward displacement of the head is more readily observed. The epiphyseal plate is usually thickened and irregular and directly beneath it in the femoral neck there may exist several areas of rarefaction and streaks of sclerosis.

That the fundamental lesion is in the epiphyseal plate is pointed out by the author. The real cause is not known but several possible contributing factors are discussed. Once slipping has begun, it is likely to progress but in some cases mild slipping may not advance even without therapy. The condition usually occurs in early adolescence and is signified by pain and limp. Most movements of the limb are free except internal rotation, which is always limited. Other details of symptomatology are mentioned.

The aim of treatment is to eliminate the epiphyseal plate at the earliest possible moment when the femoral head and neck are in a normal or nearly normal relation. For this the author prefers simple drilling of the femoral neck with penetration of the drill 1/4 inch beyond the epiphyseal plate. Two drill holes are so directed with x ray control, the drills are withdrawn and the wound closed. A long plaster spica is applied and left in place for three months during which time the patient is kept in bed. X ray check up is then done and another spica applied for another period of three months, the patient being permitted the use of crutches. A Thomas leg brace is then worn for at least six months after which time the capital epiphysis is usually found to be fused to the femoral neck. Physiotherapy is used during the brace-wearing interval. Four cases are well documented and have shown good fusion with no subsequent epiphyseolsthesis. Excellent reproductions of roentgenograms of these cases are included.

PAUL W. EYLER, M.D.

Intermuscular Lipoma of the Thigh with Roentgenologic Findings. Harold E. Simon and Hyman R. Senturia. South M J 39 624-626 August 1946.

A lipoma of the anterior thigh is reported as presenting several unusual features including an intermuscular location, resemblance to muscle hernia, a possible etiologic relationship to mild trauma suffered eight years previously and a preoperative roentgen diagnosis which was later proved by microscopic examination of the excised tumor.

The patient had a swelling on the anterior surface of

the left thigh and complained of weakness in the leg and aching, especially at night and after exercise. Roentgenograms revealed a circumscribed lobulated area of decreased density traversed by coarse trabeculations, a typical roentgen picture of lipoma. The mass was excised from its subfascial location between the vastus medius and intermedius muscles.

Lipomas are among the most frequently occurring tumors and develop in practically any structure of the body. Differential diagnosis includes muscle hernia, cysts, hemangiomas, bone tumors, sarcomas of muscle or bone, liposarcomas, dermoids with a high fat content, hernias which contain fatty tissue such as omentum, the fat of lipohemarthrosis, and cholesterol stones and accumulations.

A lipoma requires surgical removal. Correct pre-operative diagnosis, made possible roentgenographically, is highly important to insure proper treatment.

W P MARTIN, M D

OBSTETRICS AND GYNECOLOGY

Value and Limitations of Pelvioradiography in the Management of Dystocia with Special Reference to the Midpelvic Capacity. Arthur Weinberg and Samuel J. Scadron. *Am J Obst & Gynec* 52: 255-263, August 1946.

The authors present a study of 500 consecutive cases referred for x-ray examination because of dystocia, either actual or feared. All cases were studied with particular reference to the evaluation of midpelvic contraction and dystocia. The following conclusions were drawn:

1. Provided a reliable technic of roentgen pelvimetry is used, there is very little difference in roentgen mensuration.
2. The sum of the anteroposterior and the transverse diameter in any given pelvic plane is a more reliable index of the pelvic capacity than a separate consideration of each.
3. If the inlet measurements total less than 23 cm and/or the midpelvic measurements less than 14 cm, dystocia is to be expected.
4. Cephalometry and fetometry are too inaccurate to be of much importance in pelvioradiography.
5. The feto-pelvic ratio was arbitrarily decided by the use of the precision stereoscope, and not by volumetric comparisons which were too often misleading.
6. The pelvic architecture played a part in influencing the outcome, the prognosis being progressively worse in the following order: gynecoid, anthropoid, platypelloid, and android.
7. Malposition influenced the prognosis unfavorably.
8. In breech presentations, prognosis is based almost entirely on the pelvic measurements and architecture, and no trial of labor is advised. In no case where a vaginal delivery of a breech presentation was advised did such a delivery terminate with fetal mortality.
9. A correct prognosis was given in 97.8 per cent of the series.
10. Only 35 per cent of this series in which dystocia was feared required operative delivery. Sixty-five per cent were given a good prognosis illustrating the conservative influence of pelvioradiography.
11. The limitations of pelvioradiography are confined to the difficulty in estimating the soft-tissue

factors: behavior of the cervix, character of the labor contractions, the skill of the obstetrician, and the age and previous history of the patient.

HUGH A. O'NEILL, M D

Aspiration of Stomach Contents into the Lungs during Obstetric Anesthesia. Curtis L. Mendelson. *Am J Obst and Gynec* 52: 191-204, August 1946.

An analysis was made of 44,916 pregnancies to determine the incidence of aspiration of gastric contents into the lungs during anesthesia. It was found to be 0.15 per cent. Two entirely different syndromes may follow such aspiration. Aspiration of solid food usually produces the well known picture of laryngeal or bronchial obstruction with massive atelectasis and the classical x-ray picture of homogeneous density with varying degrees of mediastinal shift. Aspiration of liquids produces an asthma-like syndrome with cyanosis, tachycardia, and dyspnea; there is no mediastinal shift, and chest films show numerous, soft, mottled increased densities. The above picture has been misinterpreted as bronchopneumonia, tuberculosis, fungal infection, and even metastasis. Progressive cardiac embarrassment and pulmonary edema may supervene, and the diagnosis may then be confused with cardiac failure.

Experiments on rabbits indicated that the aspirated hydrochloric acid produced bronchial spasm and peribronchial congestive and exudative reactions interfering with normal intrapulmonary circulation.

Bronchoscopy was of no help in the treatment of this syndrome. The author suggests the oral administration of warm saline solution prior to giving anesthesia to bring on vomiting, to empty the stomach, and alkalinize the stomach contents.

FRANCIS F. HART, M D

Intrauterine Respiration of the Human Fetus. M. Edward Davis and Edith L. Potter. *J A M A* 131: 1194-1201, Aug 10, 1946.

Intrauterine respiratory activity begins in early pregnancy and is spasmodic, irregular, and shallow, but does not differ greatly from the extrauterine pattern. Intrauterine respiration is associated with circulation of amniotic fluid throughout the lungs; the major changes at birth being substitution of air for fluid and the development of a more sensitive respiratory system.

Twelve to 48 c.c. of amniotic fluid were withdrawn and replaced by thorotrast in two groups of patients: one made up of women in the first half of gestation in whom therapeutic termination of pregnancy was indicated; the other of women at or near term in whom cesarean section was anticipated. When the fetuses were delivered in seventeen to fifty-two hours, thorotrast was demonstrable in the lungs and gastro-intestinal tract roentgenographically, and histologic preparations from the first group revealed widespread distribution of thorium in bronchi and alveoli. When delivery was done thirty to sixty minutes following the instillation of thorotrast, none of the contrast substance was found in the lungs or gastro-intestinal tract. Thorotrast was present in the lungs of the youngest fetus, of approximately twelve weeks' gestation. Incidentally this was the first time that complete gastro-intestinal tract activity was demonstrated in a fetus at so early a stage. The entire gastro-intestinal tract was visualized.

In the younger fetuses, lung shadows produced by thorotrast have a finely granular appearance. In the older ones, the shadows are coarsely granular and the general pattern of the lung can be seen. Thorium is concentrated in the lungs, the result of fluid absorption by the prealveolar and alveolar circulation. Much of the amniotic fluid which enters the lung escapes in this way, some of the aspirated fluid, of course may escape back into the amniotic cavity.

Reproductions of x-rays and photomicrographs of lungs are included. **HERBERT D WELSH, M D**
(University of Michigan)

THE GENITO-URINARY SYSTEM

Experiences with Intravenous Urography in a General Hospital in India. Charles M Norfleet, Jr., and Philip J Hodes. *J Urol* 56 259-265, August 1946

In their experience in a General Hospital in India the authors made urographic studies of 410 American soldiers with urinary symptoms, using various contrast media—diodrast, pyelactan and skiodan. Evidence of some abnormality was obtained in 184 cases. Renal anomalies (including 5 cases of renal ectopia) were found in 54 (13 per cent). Forty three (10.5 per cent) had roentgen evidence of renal calculi, but the actual incidence was much higher, as in many instances the examination was made only after the calculi had been passed. Twenty-three patients (5.6 per cent) showed evidence of infection (tuberculosis in a single instance). In 31 cases (7.5 per cent) with clinical symptoms directing attention to the prostate and its neighboring structures, the urograms showed suggestive changes, chiefly involving the ureters. Among other findings were a single case of renal carcinoma, 4 ruptured kidneys, 11 cases of renal ptosis, 2 bladder neck obstructions and 1 dilatation of the middle third of the right ureter associated with intensive urinary colic and hematuria in a patient who was relieved of his symptoms following the removal of an adjacent but normal appearing appendix.

The authors emphasize the value of tests for dye sensitivity. In each of their cases an oral test was used. Although no edema of the buccal mucosa was seen there were 3 patients in whom swallowing of about 1 cc of the medium produced a sufficiently severe reaction to prohibit intravenous injection of the dye. Following injection of 2 cc of diodrast one patient in whom the oral test had been negative suffered severe nausea, vomiting and shock, but there were no fatalities. There were 2 instances of hives following diodrast injection but these yielded promptly to adrenalin. Disturbing nausea and vomiting followed pyelactan from a rubber stoppered bottle but the same patient tolerated without incident pyelactan from an ampule. Four patients receiving pyelactan had a sterile thrombophlebitis.

FREDERICK A BAVENDAM M D

Renal Ectopia. Demonstration of Crossed Unfused Ectopia by Fluoroscopy. Benjamin Resnick and John H Clark. *J Urol* 56 173-178, August 1946

Five cases of renal ectopia, 4 congenital and 1 acquired, encountered in 364 consecutive pyelographic studies are reported. This is a much higher incidence than the 1 in 1,000 generally given in the literature. Congenital uncrossed or simple ectopia is unilateral

usually involves the left kidney and is the anomaly most commonly seen.

The generally accepted view is that congenital ectopia results from a persistence of the fetal vessels interfering with normal ascent in fetal life so that the kidney becomes arrested at some point below the normal position. It has been frequently noted that ectopias are especially common among fused kidneys, as the presence of the isthmus interferes with ascent. Why the classical horseshoe kidney may be found in the normal position is difficult to explain. The suggestion that man's erect posture is a factor in the development of renal ectopia is not considered very logical, as ascent of the kidney takes place during the second month of fetal life.

Ectopia may be symptomless, but in all of the authors' cases some symptoms were present, as pain, urgency, frequency, and nocturia.

The diagnostic impressions in the 5 cases recorded were as follows: (1) ectopic left kidney (pelvic), uncrossed, (2) crossed ectopia with fusion (fusion confirmed by fluoroscopy), (3) crossed unfused ectopia, (4) uncrossed probably fused ectopia, (5) fused kidney with acquired left ectopia. The third case is of particular interest as the x-ray film suggested fusion, but fluoroscopic examination revealed a change in the relative positions of the organs and made it possible to classify the condition as a crossed unfused ectopia.

PAUL R NOBLE M D

Large Pyelogenic Cyst with Crossed Renal Ectopia. H H Lerner and A I Gazin. *J Urol* 56 162-168, August 1946

Renal ectopia is generally recorded as occurring approximately once in 1,000 cases [Norfleet and Hodes and Resnick and Clark (see preceding abstracts) report a much higher incidence]. In a year the present authors saw 9 cases: 4 of simple unilateral (1 pelvic), 2 of simple bilateral and 3 of crossed ectopia. In one of the cases of crossed ectopia there was an associated pyelogenic cyst, i.e., a cyst having a communication with the renal pelvis by a minute channel or calyx.

The patient was a colored male aged 22 years with symptoms referable to the upper gastro-intestinal tract. Physical examination showed a large tense, freely movable tumor of the abdomen extending from two inches above the umbilicus to two inches above the symphysis. It extended obliquely across the abdomen from the left upper quadrant to the right lower quadrant. X-ray examination indicated that the stomach and the distal half of the colon were displaced upward and to the right by the mass noted on physical examination. Intravenous and retrograde urography showed a left hydronephrotic kidney and slightly below it on the left side an ectopic right kidney, whose pelvis and calices were dilated and from whose superior calyx there extended a large ovoid cystic tumor with a dye capacity of 700 cc. The mass extended obliquely downward and to the right, as counting for the previously noted physical findings. Drainage through a ureteral catheter inserted in the right ureter upward as far as the right kidney pelvis caused the mass to disappear. It apparently represented a large pyelogenic cyst arising from the upper pole of a crossed hydronephrotic ectopic right kidney and communicating with its pelvis by means of the superior calyx. No note is made of operation or of clinical follow up.

MARLAN W MILLER M B

Supernumerary Kidney as a Cause of Uretero-pelvic Obstruction. Hjalmar E Carlson J Urol 56 179-182 August 1946

A case of supernumerary kidney is reported bringing the total number of recorded cases to forty-seven. Supernumerary kidneys are usually located below the normal kidney, are smaller, exhibit depressed function, and are subject to ptosis, stone, and pyonephrosis. The supernumerary kidney is more often diseased

than the normal. If diseased, it should be removed, as its poor function renders it of doubtful value. In the case reported, the supernumerary kidney was located beneath the ureteropelvic junction of the left kidney and had apparently produced obstruction resulting in a calculus pyonephrosis which had destroyed the normally situated kidney. The presence of the supernumerary organ was discovered only at operation.

PAUL R. NOBLE, M D

RADIOTHERAPY

Combined Roentgen Radiation and Surgical Treatment of Large Benign Giant Cell Tumors of Bone. G Edmund Haggart and Hugh F Hare Ann Surg 124 228-244, August 1946

There are two schools of thought concerning the treatment of benign giant-cell tumors of bone. One cautions against the combined use of radiation and surgery on the basis that the radiation will damage the reparative processes. The other contends that the two therapeutic procedures should be employed in each case. The present paper reports the results obtained in 7 cases treated first with roentgen rays, then surgically curetted.

In each case there has been complete recovery with no evidence of recurrence of the tumor and no evidence of impairment of reparative processes. In all cases the bone tumor was irradiated through two portals, using 200 kvp, 1 mm Cu at 50 cm TSD. The portals were large enough to cover the lesion. Each portal received 900 r measured in air. It was noted at the time of operation that the tumors were less vascular and were more easily curetted than in similar cases not receiving preoperative irradiation.

[This series has been followed for an average of only 4.7 years. In a paper delivered to the Philadelphia Roentgen Ray Society on Feb 6, 1947 (to be published shortly), Dr Bradley Coley, of Memorial Hospital, New York, warned of malignant change occurring after fifteen to twenty years. He advised against combining roentgen and surgical therapy except in rare instances.]

STANLEY H. MACHT, M D

Epithelioma of the Anus. Harold D Harvey Ann Surg 124 245-251 August 1946

The author presents a review of 37 cases of epithelioma of the anus seen at the Presbyterian Hospital (New York). The sex incidence was nearly equal. Over one fifth of the patients were less than forty years old. The study was undertaken to clarify the rationale for the choice of one or more of the various possible forms of treatment. Of the 37 cases, 15 are not considered because they received no treatment, or only palliative treatment. In 9, the treatment was considered unsatisfactory. Seven patients, all with extensive lesions, treated within the last three years are still alive. Six of these required abdomino-perineal resection. The seventh was treated by radium needles.

Six patients have survived five years or more. Three of these had small tumors, approximately 2 cm in diameter. In these the method of treatment was simple local excision for one, perineal proctectomy for the second and excision biopsy followed by radium pack for the third. A fourth case was successfully

treated by perineal proctectomy. A fifth with a basal squamous-cell type of epithelioma was successfully treated by interstitial radium needles, receiving a dose of 4,651 mg hours. The sixth patient, with a tumor developing after irradiation for pruritus, lived twelve years before dying of the tumor.

The author concludes by stating that no one form of treatment is applicable to all, but that each patient must be considered as an individual problem. For large growths, or growths with metastases, a radical resection of the anus and rectum with removal of the inguinal nodes should offer the best chance of arrest. If radiotherapy is used, the field of irradiation should extend well above the gross upper limits of the tumor. Radiotherapy should usually be preceded by a temporary colostomy.

PAUL W. ROMAN, M D

Sarcoma of the Vagina. William K Diehl and John S Haught Am J Obst & Gynec 52 302-310, August 1946

The authors report two cases of sarcoma of the vagina found in 8,589 gynecological admissions. Many of the vaginal sarcomas reported in the literature arise in childhood and are most commonly of the botryoid type. Adult sarcoma occurs in two forms, parietal and mucosal, the infiltrating parietal type being the more common.

These tumors are extremely malignant and are soon beyond the realm of favorable response to surgery and/or radiation. Surgery, electrosurgery, and radiation are the available means of treatment and are usually combined. Excision is most certainly indicated in the botryoid type, where the entire vagina is filled with grape like clusters, but the procedure is sometimes difficult.

Since sarcomas in general are radiosensitive, vaginal sarcoma theoretically should respond if all the cells could be brought within the effective sphere of the rays. The base of the tumor must be adequately excised in order that it may be amenable to the application of a radium plaque. This plaque usually consists of 100 mg of radium and is made to conform to the size and shape of the lesion. A large vaginal pack is used to maintain the plaque in its original position, at the same time distending the vagina and further protecting the bladder and rectum from the radium rays.

Roentgen therapy is often used as an adjunct to surgery and radium, and in these cases the total deep x ray dosage depends upon local response. Treatment is given in divided doses through the usual pelvic portals.

Local recurrences of the growth should in general be treated in the same manner as the original lesion.

BERT H. MALONE, M D

Malignant Testicular Neoplasms Analysis of 80 Cases Reed M. Nesbit and Jack M. Lynn. Surgery 20: 273-279 August 1946

A study of 80 cases of malignant disease of the testicles, none of which was followed for less than four years, has been made in an effort (1) to gain an estimate of the prognosis and to lay down criteria of an adequate follow up, (2) to determine the significance of hormone assays, (3) to judge the efficacy of early treatment, and (4) to present trends in interpretation of material submitted to the pathologist.

The patients ranged in age from 2 to 66 years, the average being 35.7. Forty-eight of the tumors were in the right testicle, 28 in the left. 3 were bilateral and one was unspecified. The early clinical picture and history in 3 cases resembled acute epididymitis, and those handling testicular tumors are warned not to be misled into delaying orchietomy or hormone assays too long. Fifty-one of the cases showed no metastases at first examination, in the 29 who did, the retroperitoneal lymph nodes and lungs were most frequently involved. Subsequent to therapy of the areas of likely involvement, metastases appeared chiefly in the retroperitoneal lymph nodes, followed by the lungs, operative site, cervical lymph nodes, mediastinal lymph nodes, and bones, in that order.

Two patients of the present series having metastases clinically demonstrable were cured by deep x-ray therapy. One has been followed for 11.5 and one for 12.5 years, respectively, with no demonstrable recurrence. The first patient, 39 years old, had had a swelling in the scrotum for fifteen years. Several months before admission the mass began to grow larger and there was pain in the lumbar region of the back. Orchietomy was performed and the diagnosis was malignant teratoma of the testicle, chiefly large round-cell sarcoma. Three months after operation there was a large mass in the left upper quadrant but the chest and spine were negative roentgenographically. One series of deep x-ray therapy was given but the number of roentgens is not specified. At two and four months after operation two series of x-ray treatments to the pelvis, abdomen and chest totalling 5200 r each, were given.

The second patient, 52 years old with a cryptorchid right testicle, was admitted with the history of swelling of the lower right side of the abdomen first noticed fifteen months previously. During the last three months, this had enlarged rapidly and an infra-umbilical mass the size of a grapefruit was present. Three preoperative deep x-ray treatments of 500 r each were given and the tumor was removed. At operation the cryptorchid testicle $6 \times 4 \times 4$ inches in size and a large mass of metastatic retroperitoneal nodes were found. Both the testicle and the biopsied lymph node revealed large round-cell alveolar sarcoma. During the five months after operation, deep x-ray treatments totalling 2600 r were given. Twelve years later there was no evidence of recurrence.

With regard to hormone assay analysis of the cases so studied shows 12 in which Aschheim Zondek tests were done both before and after treatment. One negative test subsequently became positive, and one of low titer became significantly high. If the Aschheim Zondek test is positive, the outlook is grave. Of 8 patients having hormone levels above 500 mouse units before treatment only 2 are living and all 8

with positive post therapy determinations have died.

An analysis of the survivals as related to various factors of treatment was made. Five of 19 patients treated with simple orchietomy alone were alive at the time of the report, for an average of 9.3 years but this figure is not statistically significant. Of 4 treated by orchietomy with both preoperative and postoperative irradiation, 2 were alive (average survival 12.1 years), of 17 receiving postoperative irradiation to the pelvis alone 5 were alive (average 12.4 years). None of 23 given additional radiation after completion of the original program of treatment survived five years. The authors believe that malignant testicular tumors other than chorionepithelioma should have postoperative x-ray therapy to the pelvis and abdomen whether or not metastases can be demonstrated.

In regard to the elapsed time from appearance of symptoms in a group of 10 whose treatment began within two months of onset of symptoms, and who had no demonstrable metastases, 6 patients or 60 per cent were living at an average of 9.3 years after treatment. Of 41 patients whose treatment was begun more than two months after onset of symptoms and who showed no demonstrable metastases, 13 or 31.9 per cent are living an average of 11 years after treatment. Statistically the difference is not significant but on the basis of reasoning alone, the authors advise therapy as early as possible. Preoperative x-ray therapy is not considered advisable for two reasons: (1) It makes necessary the leaving *in situ* of a malignant neoplasm which is known to metastasize early. (2) The possibility of incorrect diagnosis becomes stronger because x-ray therapy makes microscopic interpretation difficult. Figures from Memorial Hospital, however, where preoperative irradiation is used, show a higher percentage of five-year cures (29 per cent of 172 patients) than any other clinic in this country. This high level of success may be due to efficiency of the postoperative radiation rather than to the virtue of preoperative x-ray therapy and more recent communications indicate that the Memorial Hospital group now favors orchietomy without preoperative irradiation.

Under present practice, at the University of Michigan Hospital patients suspected of having neoplasms of the testicle are admitted to the ward at once and orchietomy is performed the following day, after a sample of urine has been collected for hormone assay. The spermatic cord is exposed high in the scrotum clamped and cut before any manipulation of the testicle is permitted. All patients receive postoperative x-ray therapy to the pelvis and abdomen, although the dosage is not specified.

Of the authors' entire series 23.8 per cent are living an average of 11.1 years after treatment. Two of the 39 having metastases at the time of diagnosis were seemingly cured by x-ray therapy. 51 patients with no demonstrable metastases when first seen had a survival rate of 33.33 per cent.

Mention is made of the wide divergence of opinion among leading pathologists regarding grouping of testicular neoplasms. It is pointed out that once orchietomy has been carried out and adequate postoperative x-ray therapy has been given the course cannot be altered by further therapy. Metastases occurring after the first adequate series of x-ray treatments have not been affected by further therapy.

J. E. WHITEBATHER, M.D.

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